A330
TECHNICAL TRAINING MANUAL
MECHANICAL & AVIONICS COURSE - T1+T2 (LVL 2&3)
(RR Trent 700)
FLIGHT CONTROLS

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FLIGHT CONTROLS

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW

INTRODUCTION

The fly by wire flight control system controls:
- the primary flight controls which control the pitch, roll and yaw axis,
- the secondary flight controls which include the speed brakes and ground spoilers (Lift dumping),
- the high lift function which includes the flaps and slats .

The flight control system is monitored by the Onboard Maintenance System (OMS) for maintenance and troubleshooting functions. When doing maintenance on the aircraft, all safety procedures listed in the Aircraft Maintenance Manual (AMM) must be applied.
Let's see their location on the A/C.

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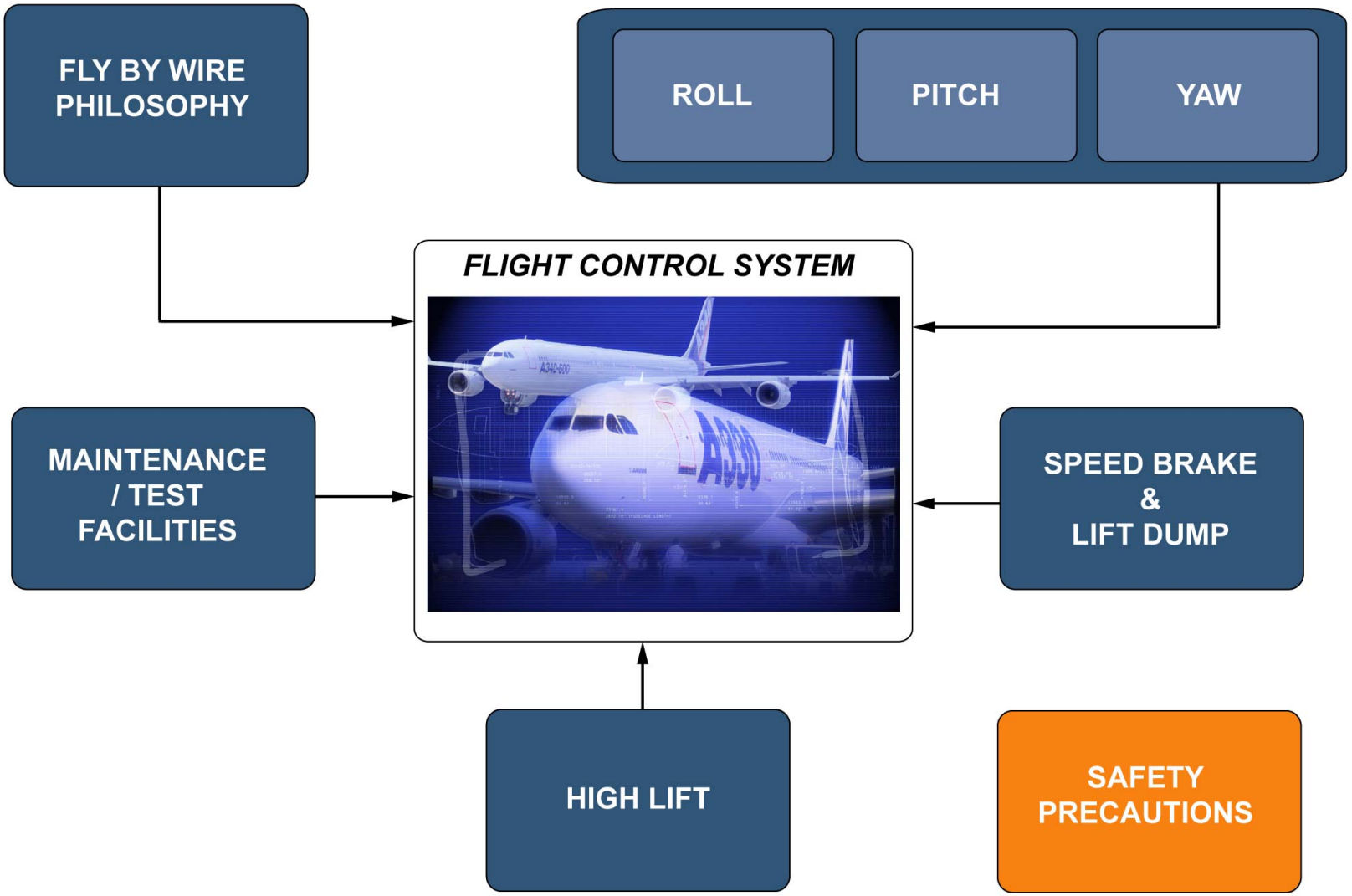
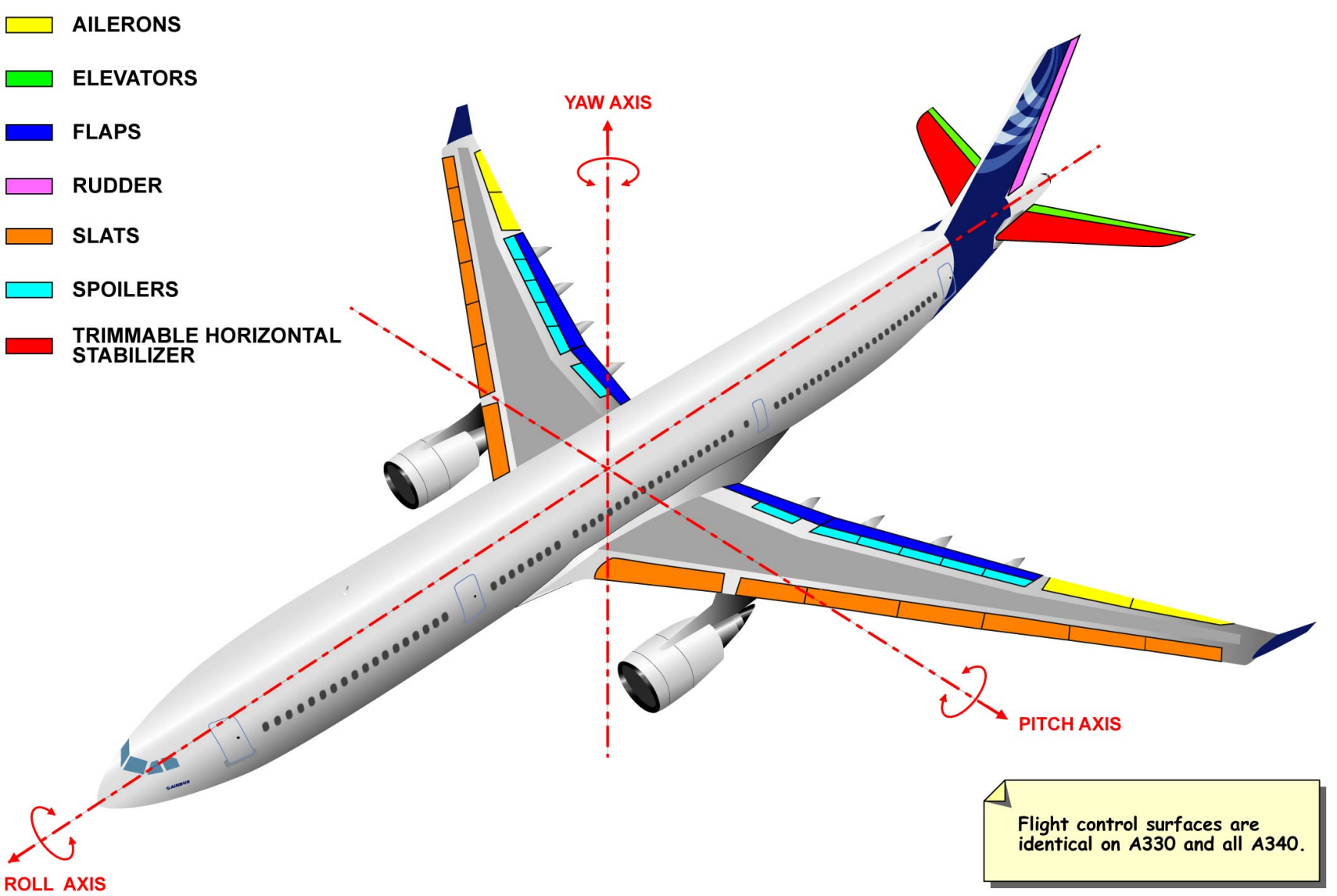


SYSTEM OVERVIEW - INTRODUCTION



SYSTEM OVERVIEW - INTRODUCTION

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

FLIGHT CONTROLS ARCHITECTURE

The three FCPCs, also called "PRIM", and the two FCSCs, also called "SEC", receive pilot orders from:
- the side sticks,
- the rudder pedals,
- the rudder trim control panel
- the speed brake control lever.

The FCPCs receive autopilot inputs from the Flight Management Guidance and Envelope Computers (FMGECs). The FCPCs and FCSCs interface together. They control and monitor:
- the ailerons,
- the spoilers,
- the elevators,
- the rudder.

The THS is electrically controlled by the FCPCs only.
The THS can also be mechanically operated through the trim wheel.
In case of loss of the FCPCs and FCSC1, the Backup Control Module (BCM) controls the aircraft yaw via the rudder.
The two Flight Control Data Concentrators (FCDCs) interface the FCPCs and FCSCs with:
- the Electronic Instrument System (EIS),
- the Centralized maintenance system (CMS),
- the recording system.

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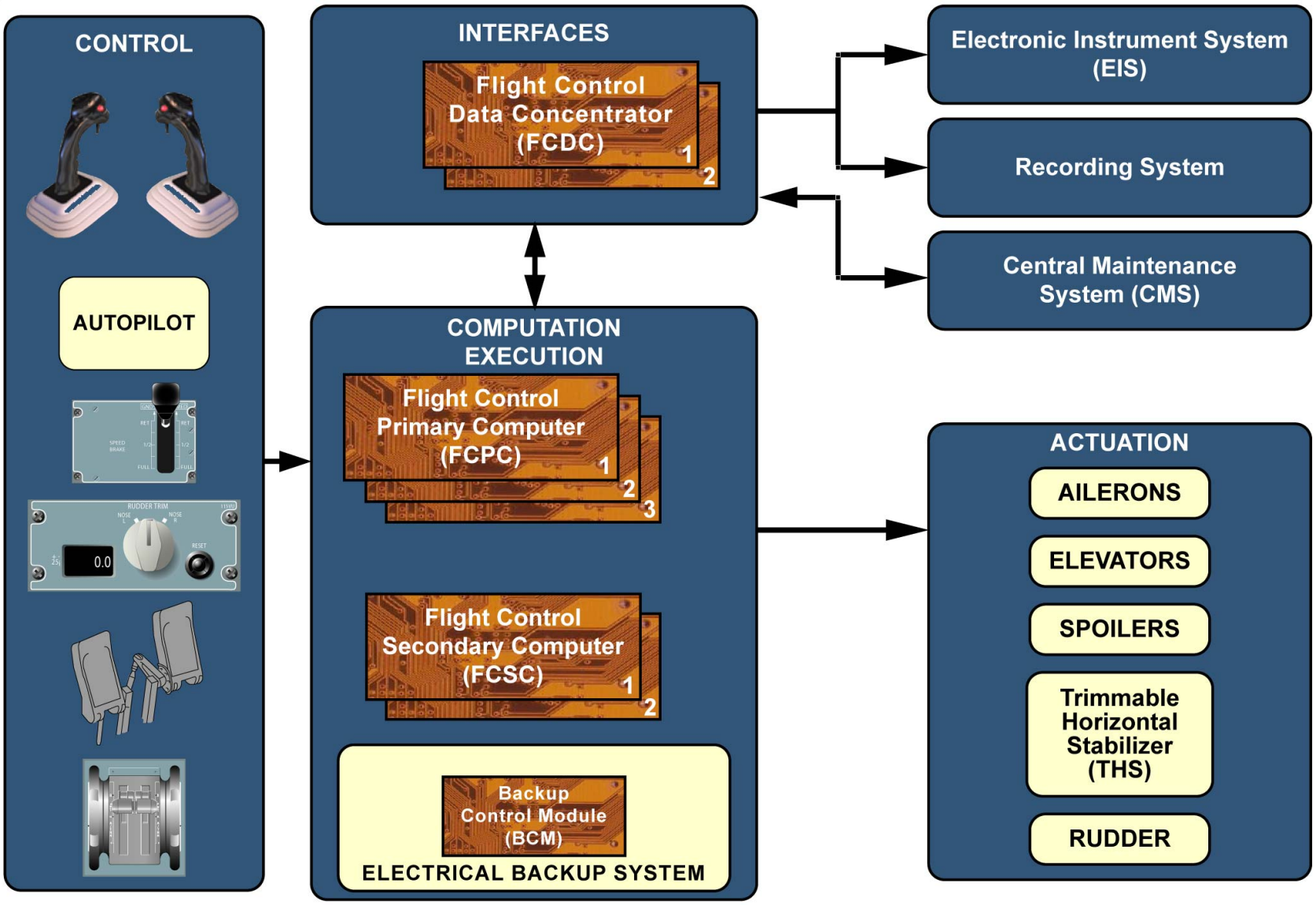

SYSTEM OVERVIEW - FLIGHT CONTROLS ARCHITECTURE

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

FLY BY WIRE PRINCIPLE

The relation between the pilot input on the side stick and the aircraft response is called control law. The pilot's side stick orders are sent to the flight control computers. The computers elaborate the control law surface deflection orders. An electrical command signal is sent to the related surfaces servo actuator. The aircraft response feedback is sent back to the flight control computers and compared to the pilot orders. The fly by wire design requires the aircraft to be servo-looped.

NOTE: Note: Side stick electrical command signals are sent to the computers, which elaborate surface deflection orders and send electrical command signals to servo-actuators to move surfaces. It replaces the mechanical link found on conventional aircraft flight control systems.

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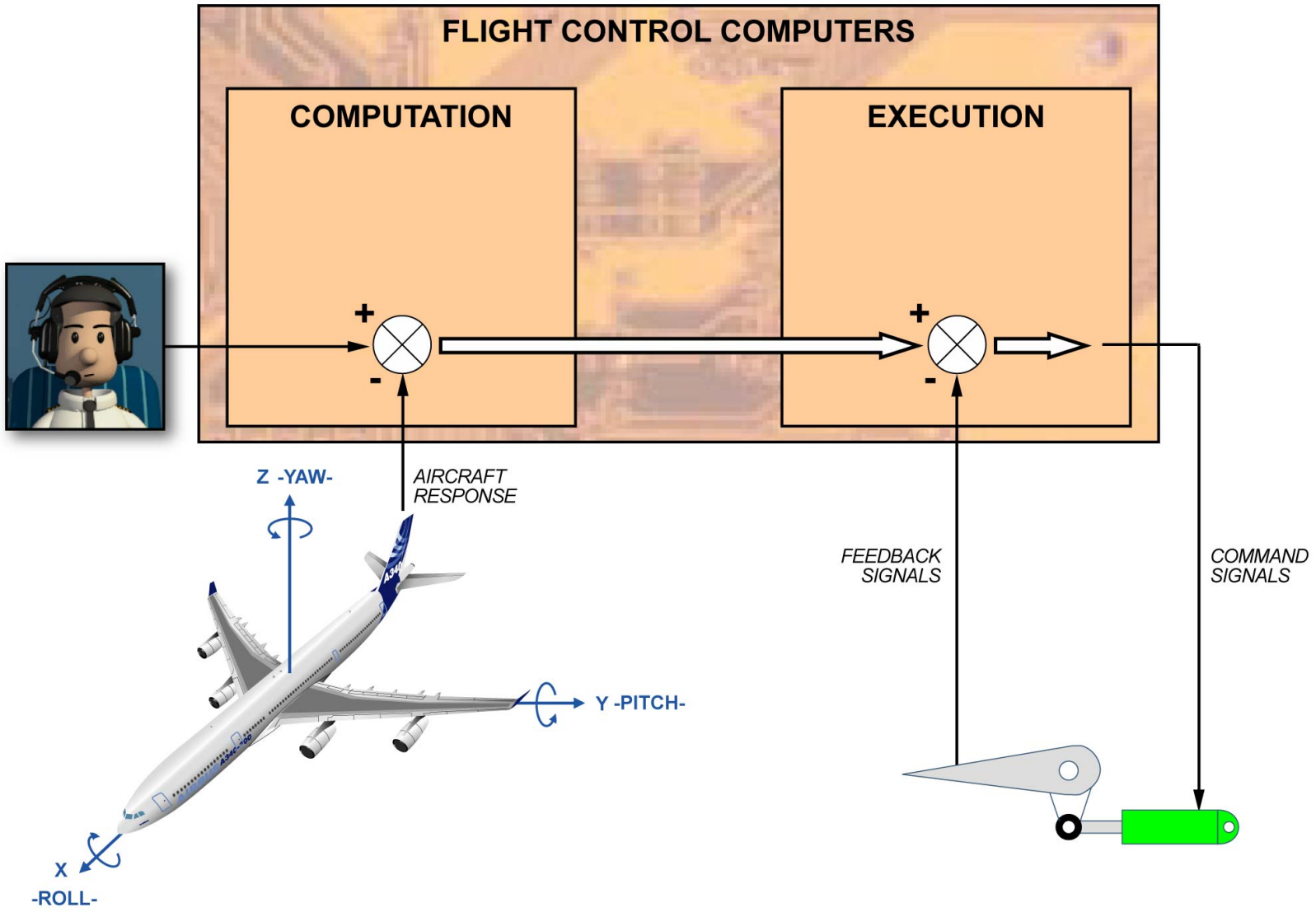

SYSTEM OVERVIEW - FLY BY WIRE PRINCIPLE

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

COMPUTER MASTER / SERVO LOOP CONFIGURATION

The 3 FCPCs and the 2 FCSCs fulfill two functions:
- the computation part which elaborates the surface deflection orders,
- the execution part which fulfills the servoing of the deflection orders.

One computer only (FCPC 1 in normal configuration) is the master. This computer generates the deflection orders and transmits them to the other computers. The five computers signal their related surfaces and fulfill the servo loop controls.

Each computer establishes the highest level of law that can be engaged according to its internal monitoring and the availability of ADIRUs, control signals, surface actuation and the positions of the THS, the flaps and the slats.

The computer which has the highest level of law, and according to the computer priority, is the master for law computation: normally FCPC 1, then FCPC 2 and 3.

Among the computers which can engage the highest level of law, the computer having the top priority is chosen.

NOTE: Note: the priority logic for law engagement is totally independent from the servo-loop engagement logic.

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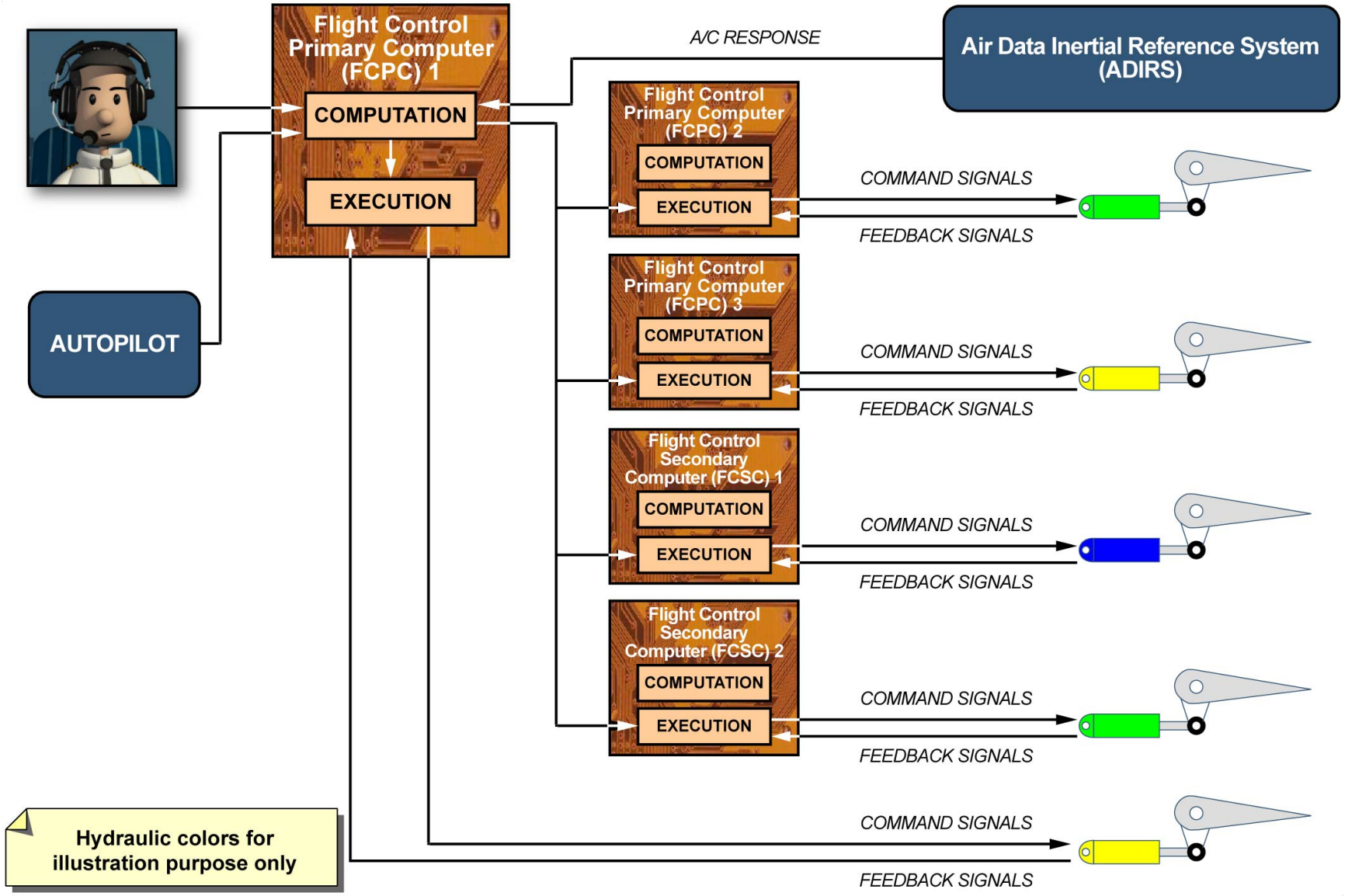

SYSTEM OVERVIEW - COMPUTER MASTER / SERVO LOOP CONFIGURATION

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

FLIGHT CONTROL LAWS

The deflection orders are processed by the flight control system according to different control laws. The aircraft is controlled in all axes through:
- the pitch control law,
- the lateral control law (roll and yaw).

Depending on the status of the flight control system or other systems (number of computers available, status of peripheral components and sensors) three different sets of control laws can be engaged:
- the normal law, with all protections,
- the alternate law, with reduced protections,
- the direct law, without protections.

Control laws automatically switch from normal to alternate or direct according to the nature and number of failures. After loss of normal laws, the reconfiguration of control laws is different for the pitch axis and for the lateral axis.

The normal law is only implemented in the FCPCs. The FCSCs can only compute the yaw alternate law and the direct law.

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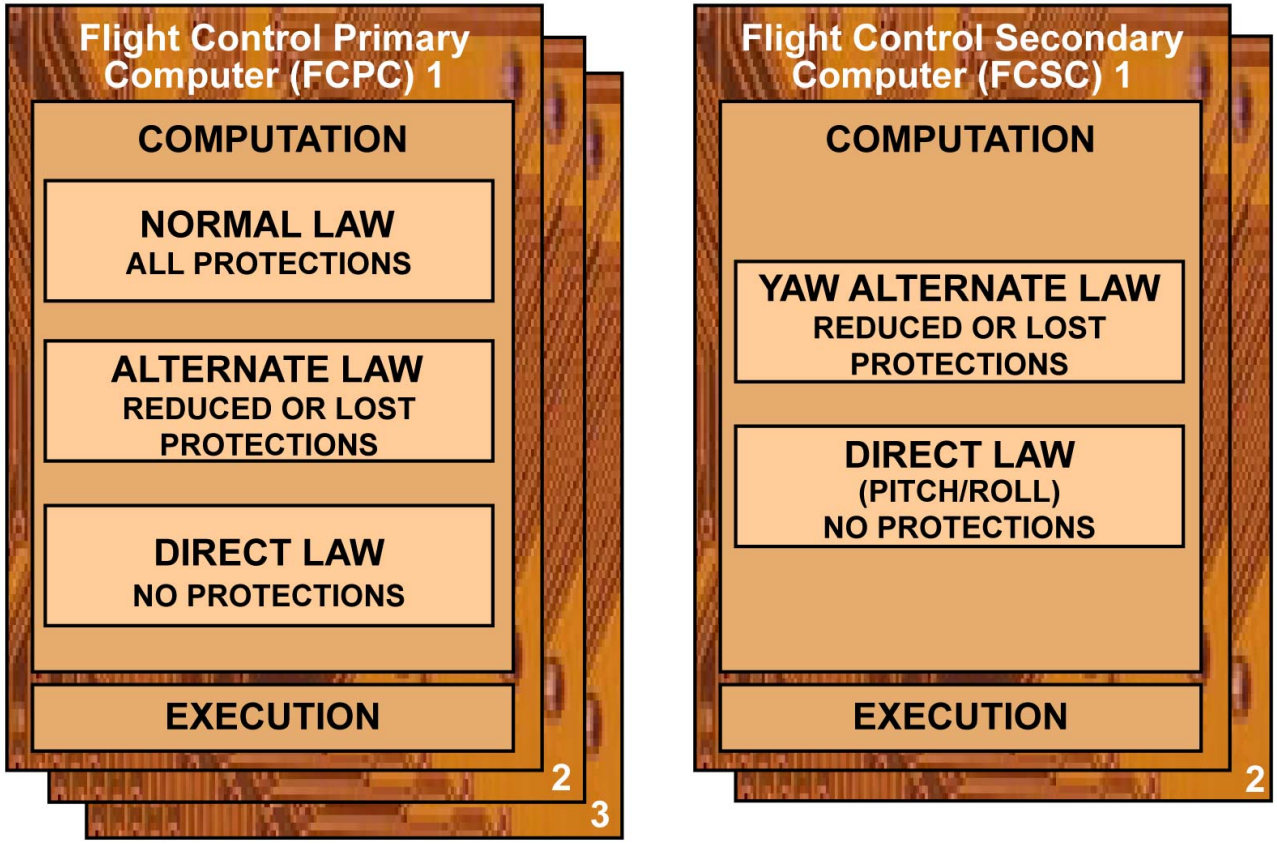

SYSTEM OVERVIEW - FLIGHT CONTROL LAWS

FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

ACTUATION RECONFIGURATION PRIORITY

ACTUATORS

The actuators are hydraulically powered by one of the three hydraulic circuits, except the THS servo-motors which are electrically driven.
Roll control is done by the one inboard and one outboard aileron on each wing and the roll spoilers (spoilers 2 through 6). The aileron droop function is provided by all the ailerons. The ailerons are deflected downwards when the flaps are extended to follow the contours of the wing. The aileron droop function increases the lift on the part of the wing with no flaps.
The pitch control is done by the elevators and by the Trimmable Horizontal Stabilizer (THS). The trim wheel can also mechanically control the hydraulic motors. The trim wheel has priority over the electrical control. The mechanical control is used:
- on ground, for setting the THS take-off trim,
- in flight, as a back-up system if THS electrical control is lost.

The rudder fulfills the yaw control. The Pedal Feel and Trim Unit (PFTU) gives rudder pedal artificial feel, trim function and feedback movement.
The Backup Control Module(BCM) is an electronic module, which fulfills the yaw control in case of flight control computer failures. The Backup Power Supplies (BPSs) supply electrical power to the BCM from two hydraulically driven motors. The BCM transmits the rudder pedals order to the rudder, and also fulfills dutch roll damping. The PFTU interfaces the BCM with the pedals.
All spoilers fulfill the speed brake function. All the spoilers fulfill the ground lift dump function when specific ground logic conditions are fulfilled.

COMPUTERS

The relationship between actuators and computer is indicated on the schematic.

PRIORITY SERVOCONTROLS

There are two servo controls for each aileron and elevator surface. In normal configuration, one servo control actuates the surface. It is called priority servo control and is in active mode. The second, which follows the surface deflection, is in damping mode.
A third mode called re-centering sets the surfaces in neutral position in case of specific failures (for elevators on all A330, 340 and also inboard ailerons for A340-500/600).
There are three servo controls for the rudder. Alls are active at the same time.
There is only one servo control per spoiler.

RECONFIGURATION PRIORITIES

In normal configuration, the following computers ensure the servoloop control. The arrows indicate the actuation reconfiguration priorities in case of either electrical failure, computer failure or loss of hydraulic circuits.

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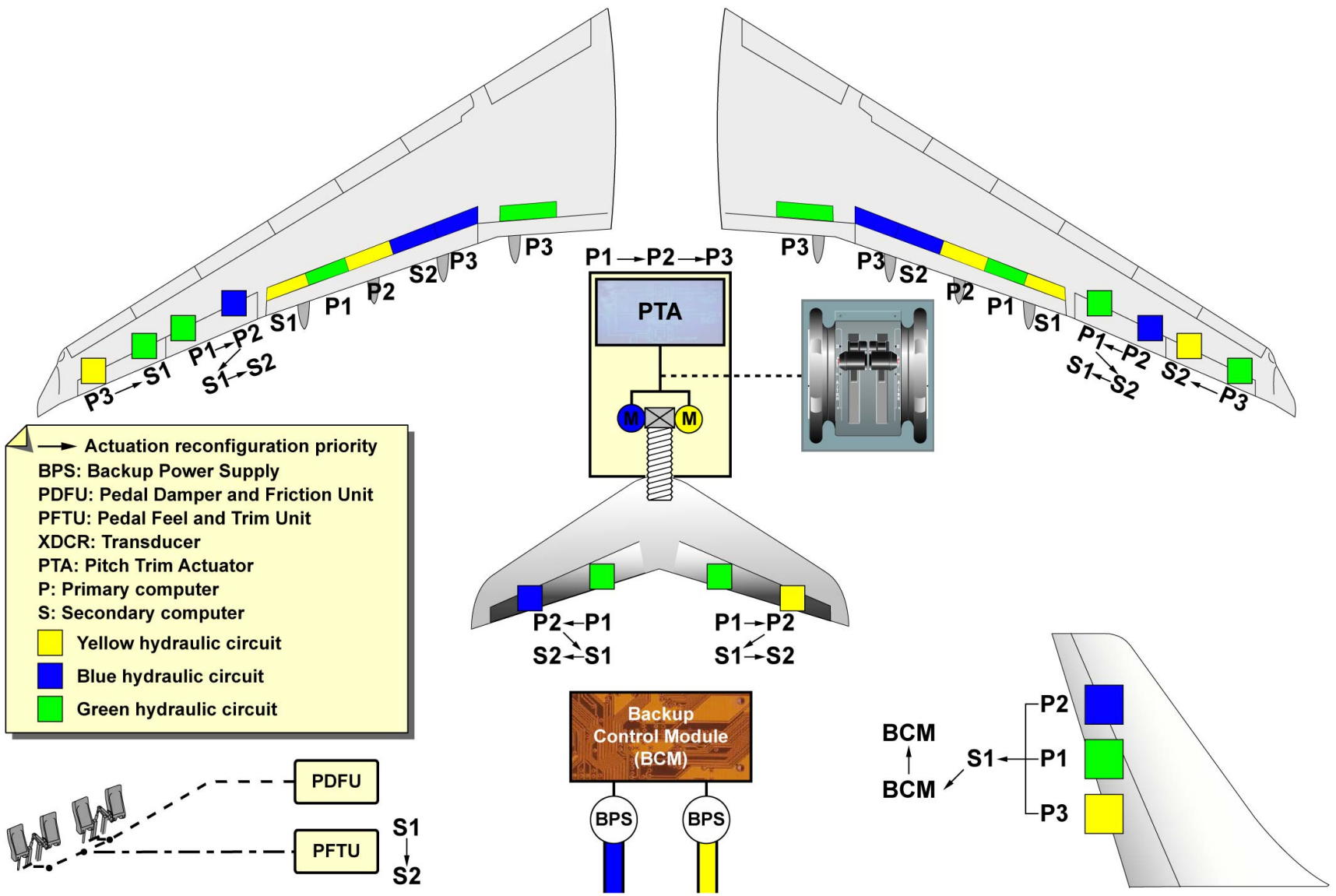

ACTUATION RECONFIGURATION PRIORITY - ACTUATORS ... RECONFIGURATION PRIORITIES

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FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

MEL/DEACTIVATION

DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

The procedure is similar for each of the outboard aileron servocontrols.
Put the related hydraulic system in the depressurized configuration before maintenance action:
- open, safety and tag the circuit breakers related to the Engine Driven Pump (EDP) and Electrical pumps,
- make sure that there is no hydraulic supply from a ground power cart,
- check on the ECAM SD HYD page that the pressure of the related hydraulic system is 0 psi,
- put the warning notices in position to tell persons not to pressurize the related hydraulic system on the hydraulic control panel in the cockpit and on the ground service panel of the related hydraulic system.

Place a warning notice in the cockpit to tell persons not to operate the flight controls.
Open, safety and tag all the circuit breakers related to the Flight Control Computers (FCPC and FCSC).
Make sure that the pressure and the return lines are correctly connected to the servocontrol and check that there is no hydraulic leakage at the servocontrol. Disconnect the electrical connector from the receptacle of the servocontrol and place blanking caps on both connector and receptacle to protect them. Do not forget to safely attach the connector to a pipe with a tie-wrap.
Remove the tags and close all the previously Flight Control Computers (FCPC and FCSC) opened C/Bs.
To do the operational test of the aileron hydraulic actuation, make sure that the deactivated servocontrol does not operate.
o use the LEAK MEASUREMENT VALVES P/BSW, isolate the other servocontrol which has not to be tested,
o use the LEAK MEASUREMENT VALVES P/BSW in order to isolate the other servocontrol which has not to be tested,
o operate the side stick to move the aileron.
If no other servicing tasks have to be completed, the area can be closed.
A warning notice will be placed in the cockpit to tell the crew that the outboard aileron servocontrol is unserviceable and an entry has to be made in the logbook.

NOTE: The C/Bs 7CE3 and 7CE4 have to be closed at the same time. If this operation is not properly done, the FAULT legend of the primary (PRIM) 3 P/BSW comes on. In this case, repeat the opening and closing of both C/Bs.

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Make sure that hydraulic systems are depressurized.

Open, safety and tag this(these) circuit breaker(s):

PANEL	DESIGNATION	FIN	LOCATION
721VU	HYD PUMP G CTL	9JV	U09
721VU	HYD PUMP B ENG 1	11JB	U08
721VU	HYD PUMP B CTL	9JC	X12
722VU	HYD PUMP Y SVCE	10JJ	N46
722VU	HYD PUMP Y CTL	9JJ	R36
722VU	HYD PUMP Y ENG 2	12JY	T46
722VU	HYD PUMP G ENG 2	14JG1	X45
722VU	HYD PUMP G ENG 1	14JG2	E67

A330 Circuit Breakers shown as example.

Make sure that warning notice is set in the cockpit.

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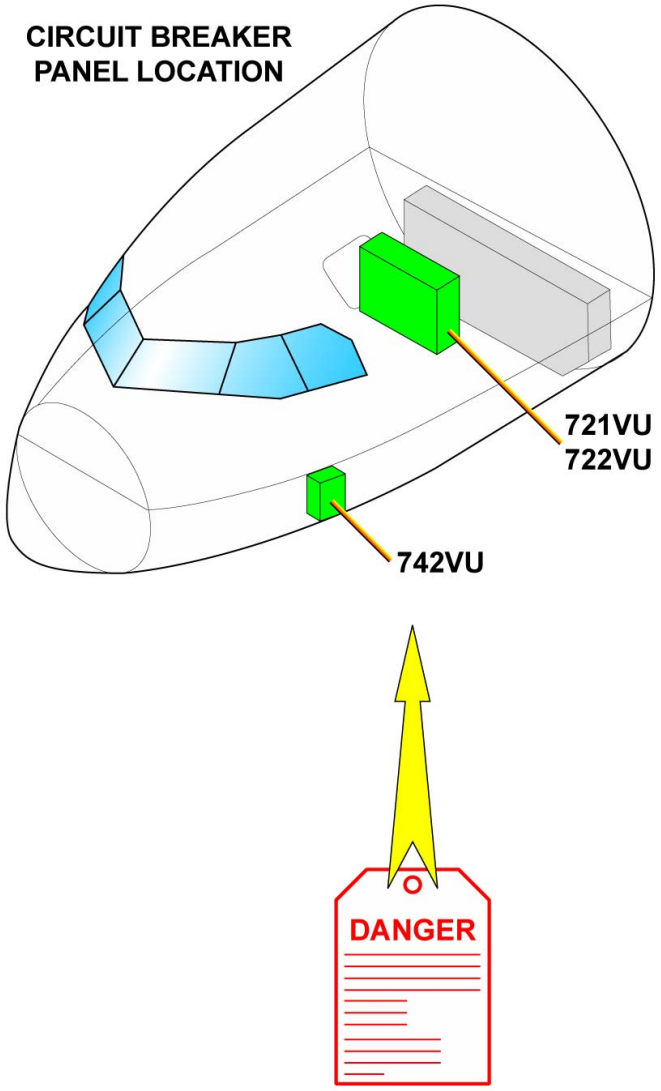
MEL/DEACTIVATION - DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

Open and tag the Circuit Breakers:

PANEL	DESIGNATION	FIN	LOCATION
FOR 9CS1			
742VU	FCSC 1 NORM	10CE1	C67
FOR 10CS1			
721VU	FCPC3 STBY COM	7CE6	R20
721VU	FCPC3 STBY MON	7CE5	R19
722VU	FCPC 3	7CE3	V42
722VU	FCPC 3	7CE4	V38
FOR 9CS2			
722VU	FCSC 2	10CE2	T37
742VU	FCSC2 STBY SPLY	41CE	D66
FOR 10CS2			
721VU	FCPC3 STBY COM	7CE6	R20
721VU	FCPC3 STBY MON	7CE5	R19
722VU	FCPC 3	7CE3	V42
722VU	FCPC 3	7CE4	V38

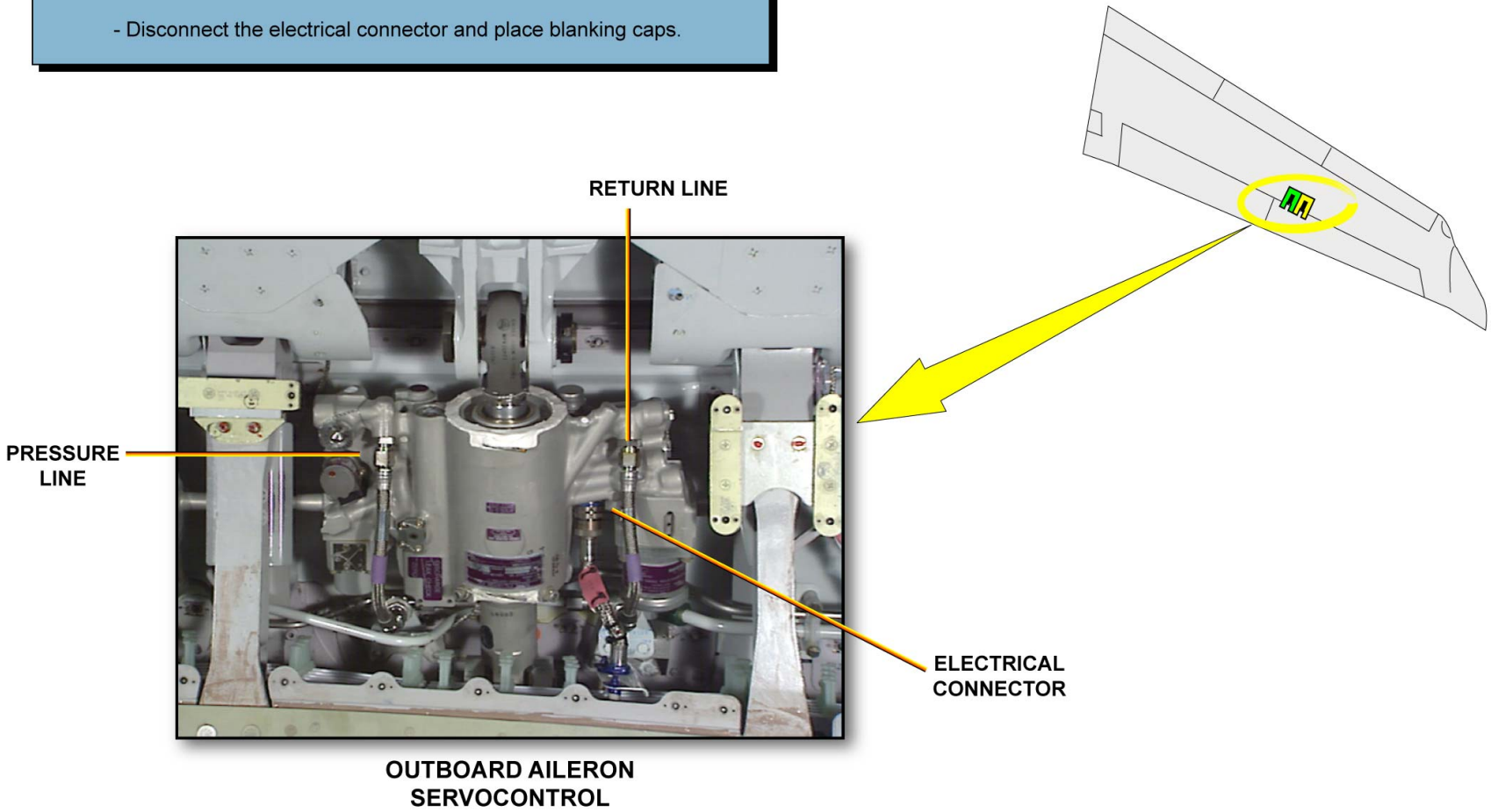


MEL/DEACTIVATION - DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

Deactivation of the servocontrol:

- Make sure that the pressure and the return line are connected and check for no hydraulic leakage.

- Disconnect the electrical connector and place blanking caps.

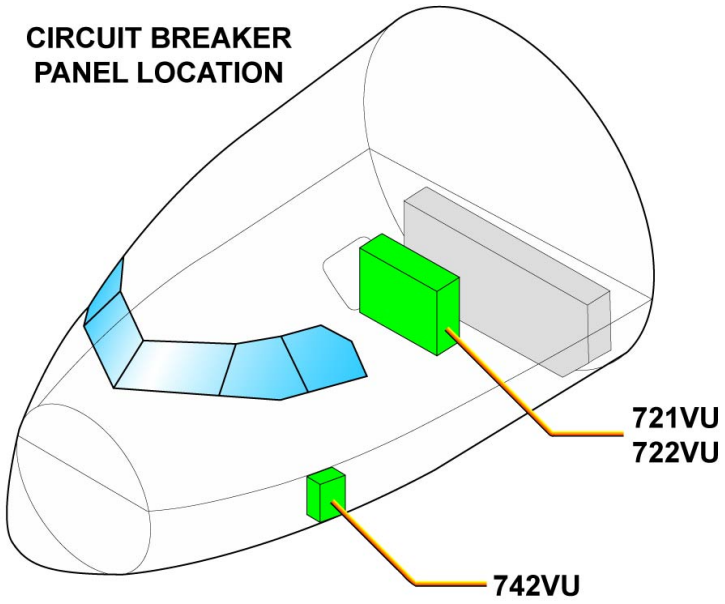


MEL/DEACTIVATION - DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

A330 Circuit Breakers shown as example.

Remove the tags and close the Circuit Breakers:

PANEL	DESIGNATION	FIN	LOCATION
FOR 9CS1			
	742VU FCSC 1 NORM	10CE1	C67
FOR 10CS1			
	721VU FCPC3 STBY COM	7CE6	R20
	721VU FCPC3 STBY MON	7CE5	R19
	722VU FCPC 3	7CE3	V42
	722VU FCPC 3	7CE4	V38
FOR 9CS2			
	722VU FCSC 2	10CE2	T37
	742VU FCSC2 STBY SPLY	41CE	D66
FOR 10CS2			
	721VU FCPC3 STBY COM	7CE6	R20
	721VU FCPC3 STBY MON	7CE5	R19
	722VU FCPC 3	7CE3	V42
	722VU FCPC 3	7CE4	V38



Remove the tags and close the C/Bs:

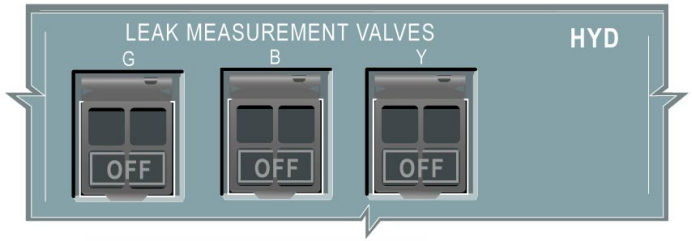
PANEL	DESIGNATION	FIN	LOCATION
721VU	HYD PUMP G CTL	9JV	U09
721VU	HYD PUMP B ENG 1	11JB	U08
721VU	HYD PUMP B CTL	9JC	X12
722VU	HYD PUMP Y SVCE	10JJ	N46
722VU	HYD PUMP Y CTL	9JJ	R36
722VU	HYD PUMP Y ENG 2	12JY	T46
722VU	HYD PUMP G ENG 2	14JG1	X45
722VU	HYD PUMP G ENG 1	14JG2	E67

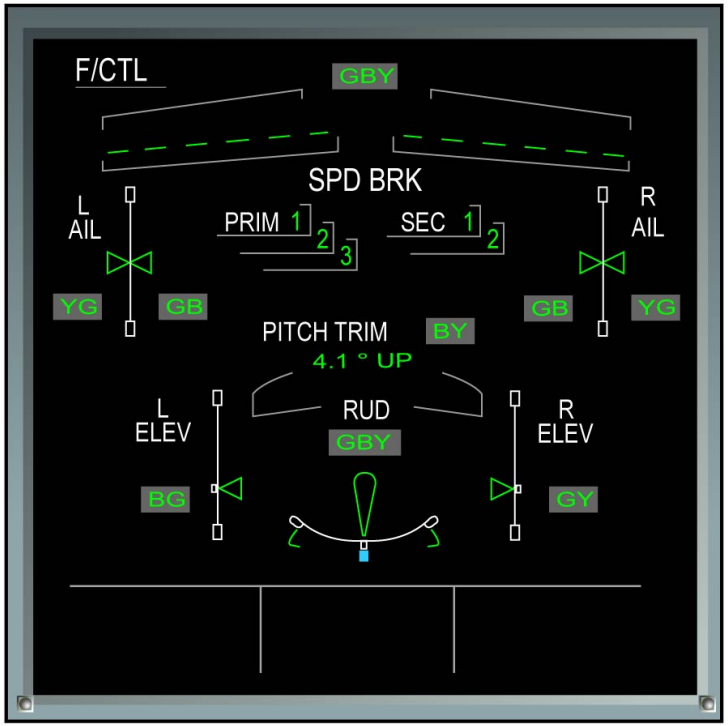
The Circuit Breakers 7CE3 and 7CE4 have to be closed at the same time.

If this operation is not done correctly, the FAULT legend of the PRIM 3 P/BSW comes on (only with the P/BSW pushed). In this case, replay the opening and closing of both Circuit Breakers.

MEL/DEACTIVATION - DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

Operational test and hydraulic actuation.





ECAM SD

A warning notice will be placed in the cockpit to tell the crew that the outboard aileron servocontrol is unserviceable and an entry has to be made in the logbook.

MEL/DEACTIVATION - DEACTIVATION OF THE OUTBOARD AILERON SERVOCONTROL

FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

MEL/DEACTIVATION (continued)

DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

The Pitch Trim Actuator (PTA) controls the THS hydraulic motors. The PTA has three brushless Direct Current (DC) motors. Each electrical motor is connected to one FCPC.

NOTE: The deactivation is given for the electrical motor 1 but the procedure is the same for motors 2 and 3.

Put the related hydraulic system in the depressurized configuration before maintenance action:
- open, safety and tag the circuit breakers related to the EDP and Electrical pumps,
- make sure that there is no hydraulic supply from a ground power cart,
- check on the ECAM SD HYD page that the pressure of the related hydraulic system is 0 psi,
- put the warning notices in position to tell persons not to pressurize the related hydraulic system on the hydraulic control panel in the cockpit and on the ground service panel of the related hydraulic system.

On the FLT CTL section of the overhead panel, make sure that the PRIM 1, PRIM 2, PRIM 3, SEC 1 and SEC 2 P/BSWs are pressed in the ON position and no indications on the P/BSWs are on.
In the avionics compartment, get access to the C/B panels. Open, safety and tag the C/B related to the electrical motor, as shown in the table.

NOTE: Open only the C/Bs of the THS actuator electrical motor to deactivate it.

Pressurize the aircraft hydraulic systems. Push the F/CTL key to show the F/CTL page on the SD. On the EWD, make sure that the F/CTL PRIM 1 PITCH FAULT warnings are shown.
On the two F/CTL panels, release out PRIM 1, 2 and 3 P/BSWs. The OFF indications come on. Move the pitch trim control wheels located on the center pedestal to the fully UP position. Press in the PRIM 1 P/BSW located on the FLT/CTL section of the panel 241VU and make sure that the pitch trim control wheels do not move.
On the EWD, check that the F/CTL STAB CTL FAULT warning message comes on.
Do the BITE test of the Electrical Flight Control System (EFCS) via the GND SCANNING command and make sure that the subsequent maintenance message is shown:
- FCPC1 (2CE1)/WRG/THS ACTR CIRCUIT BREAKER TO FCPC 1, as the circuit breaker for THS actuator motor 1 is open.

Press in the PRIM 2 and PRIM 3 P/BSWs, the OFF indications disappear. Check that the pitch trim control wheels automatically move back to the 4° UP position.
Depressurize the aircraft hydraulic systems. If no other servicing tasks have to be completed, the area can be closed. Put a warning notice in the cockpit to tell the flight crew that one THS actuator motor (1, 2 or 3) is deactivated. Do not forget to make an entry in the A/C technical logbook.

NOTE: If the ECAM warning PRIM 1(2)(3) PITCH FAULT related to the class 1 maintenance message F/CTL PRIM 1 PITCH FAULT EFCS 1(2) PITCH TRIM ACTR 1 was shown; the inspection of the ball screw assembly for integrity of the primary and secondary load paths must be done (Ref. TASK 27-44-51-210-805).

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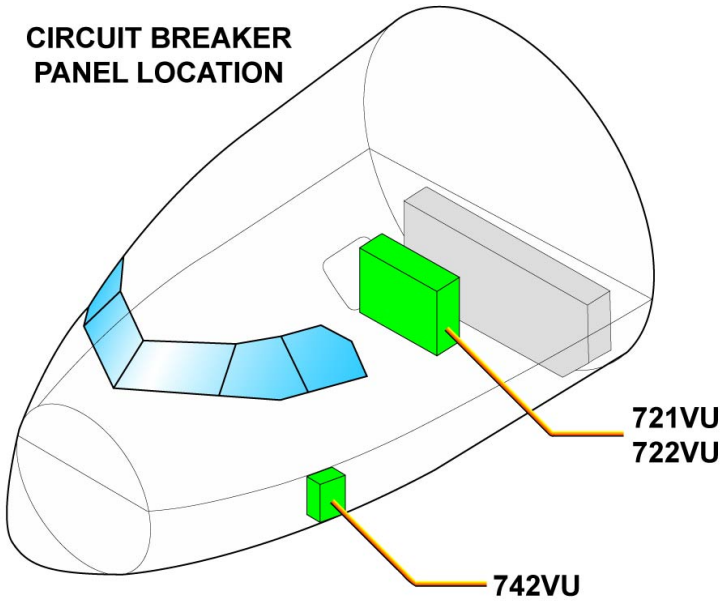
A330 Circuit Breakers shown as example.

Remove the tags and close the Circuit Breakers:

PANEL	DESIGNATION	FIN	LOCATION
FOR 9CS1			
	742VU FCSC 1 NORM	10CE1	C67
FOR 10CS1			
	721VU FCPC3 STBY COM	7CE6	R20
	721VU FCPC3 STBY MON	7CE5	R19
	722VU FCPC 3	7CE3	V42
	722VU FCPC 3	7CE4	V38
FOR 9CS2			
	722VU FCSC 2	10CE2	T37
	742VU FCSC2 STBY SPLY	41CE	D66
FOR 10CS2			
	721VU FCPC3 STBY COM	7CE6	R20
	721VU FCPC3 STBY MON	7CE5	R19
	722VU FCPC 3	7CE3	V42
	722VU FCPC 3	7CE4	V38



Remove the tags and close the C/Bs:

PANEL	DESIGNATION	FIN	LOCATION
721VU	HYD PUMP G CTL	9JV	U09
721VU	HYD PUMP B ENG 1	11JB	U08
721VU	HYD PUMP B CTL	9JC	X12
722VU	HYD PUMP Y SVCE	10JJ	N46
722VU	HYD PUMP Y CTL	9JJ	R36
722VU	HYD PUMP Y ENG 2	12JY	T46
722VU	HYD PUMP G ENG 2	14JG1	X45
722VU	HYD PUMP G ENG 1	14JG2	E67

The Circuit Breakers 7CE3 and 7CE4 have to be closed at the same time.

If this operation is not done correctly, the FAULT legend of the PRIM 3 P/BSW comes on (only with the P/BSW pushed). In this case, replay the opening and closing of both Circuit Breakers.

MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

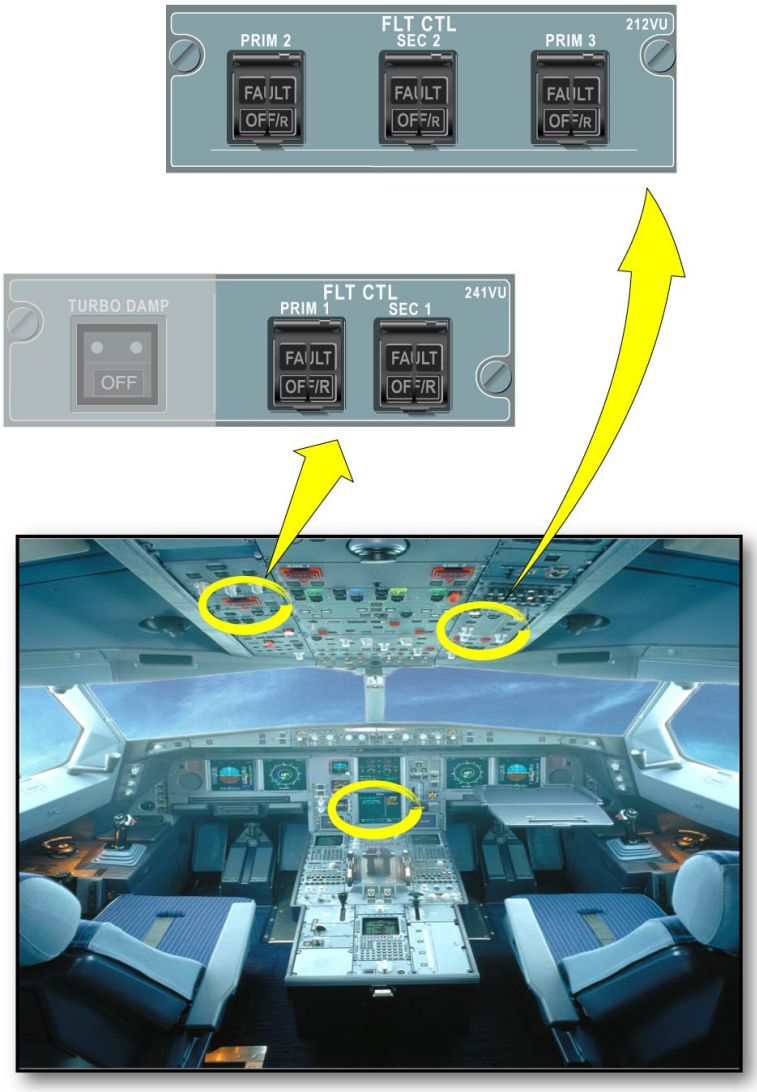
Make sure that hydraulic systems are depressurized.

A330 Circuit Breakers shown as example.

Open, safety and tag this(these) circuit breaker(s):

PANEL	DESIGNATION	FIN	LOCATION
721VU	HYD PUMP G CTL	9JV	U09
721VU	HYD PUMP B ENG 1	11JB	U08
721VU	HYD PUMP B CTL	9JC	X12
722VU	HYD PUMP Y SVCE	10JJ	N46
722VU	HYD PUMP Y CTL	9JJ	R36
722VU	HYD PUMP Y ENG 2	12JY	T46
722VU	HYD PUMP G ENG 2	14JG1	X45
722VU	HYD PUMP G ENG 1	14JG2	E67

Make sure that PRIM 1, PRIM 2, PRIM 3, SEC 1, SEC2 press in ON position.

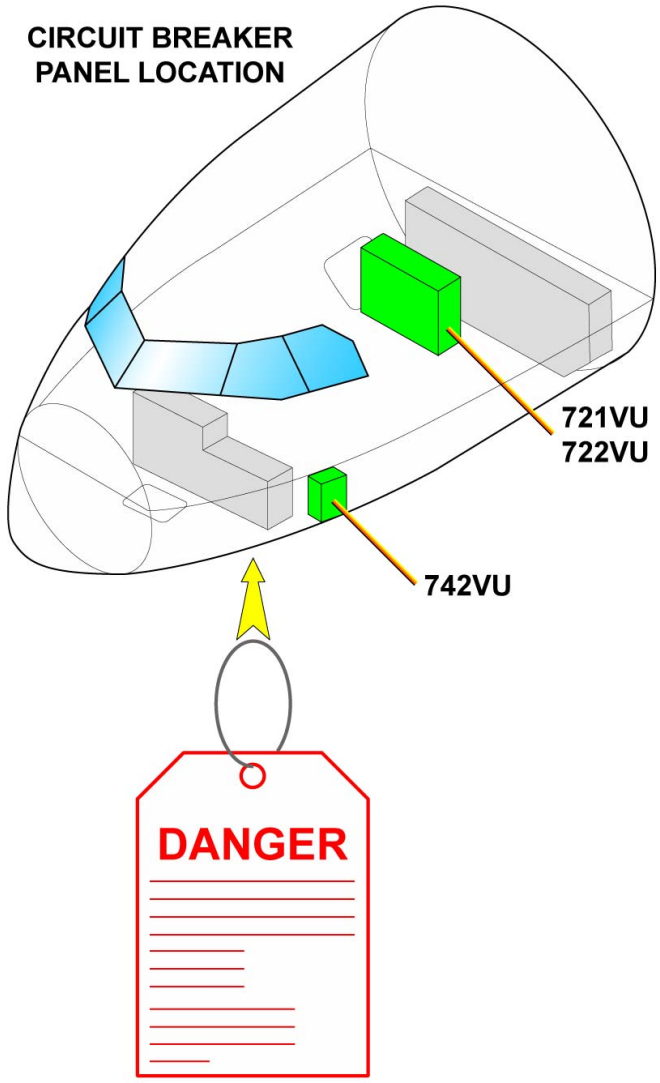


MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

Open and tag the Circuit Breakers:

PANEL	DESIGNATION	FIN	LOCATION
For the THS Actuator Motor 1			
742VU	THS ACTR MOT 1	5CS1	L77
For the THS Actuator Motor 2			
721VU	THS ACTR MOT2 STBY	34CS	W14
722VU	THS ACTR MOT2 NORM	5CS2	V43
For the THS Actuator Motor 3			
722VU	THS ACTR MOT 3	5CS3	V44

Open only the circuit breakers of the THS actuator motor to deactivate it.



MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

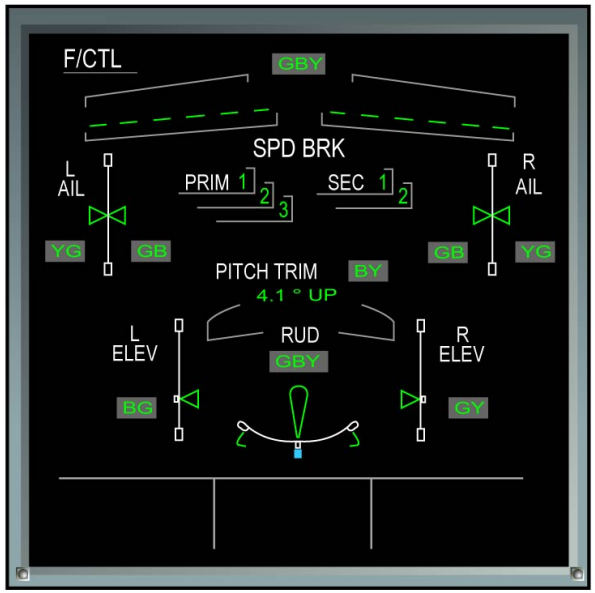
Pressurize the hydraulic systems.

Remove the tags and close the C/Bs:

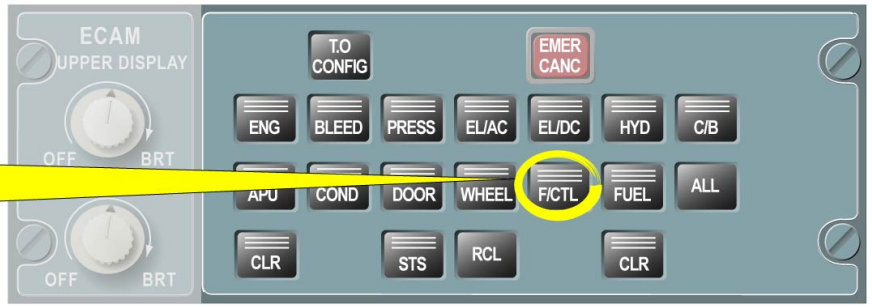
PANEL	DESIGNATION	FIN	LOCATION
721VU	HYD PUMP G CTL	9JV	U09
721VU	HYD PUMP B ENG 1	11JB	U08
721VU	HYD PUMP B CTL	9JC	X12
722VU	HYD PUMP Y SVCE	10JJ	N46
722VU	HYD PUMP Y CTL	9JJ	R36
722VU	HYD PUMP Y ENG 2	12JY	T46
722VU	HYD PUMP G ENG 2	14JG1	X45
722VU	HYD PUMP G ENG 1	14JG2	E67

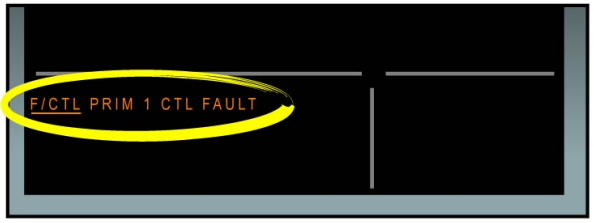
A330 Circuit Breakers shown as example.

Select the F/CTL page and check the warning on the EWD.



ECAM CONTROL PANEL (ECP)(100VU)

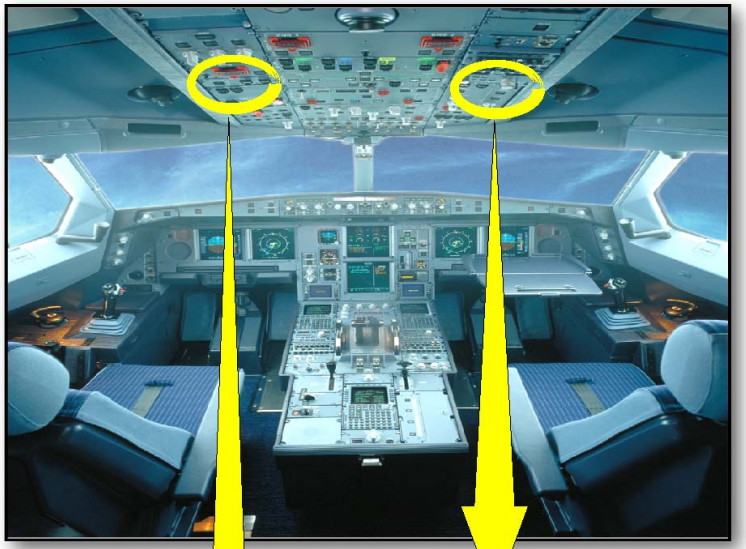


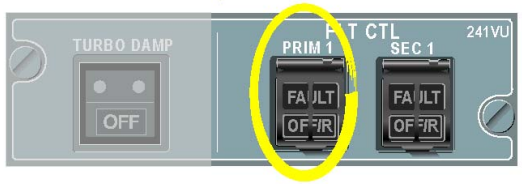


ECAM EWD

MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

G9409341 - GAUT0T0 - FM27B1000000001

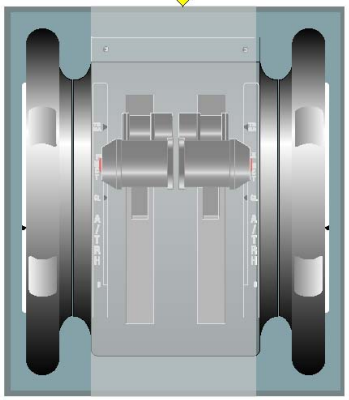




Release out the PRIM 1, PRIM 2, PRIM 3, P/BSWs.

Move the pitch trim control wheels to the fully UP position.

Push the PRIM 1 and check that the pitch trim do not move.



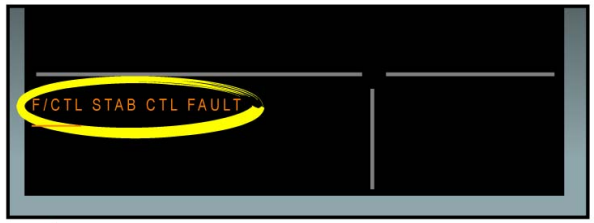
PITCH TRIM CONTROL WHEELS

A330 trim wheel as an example.

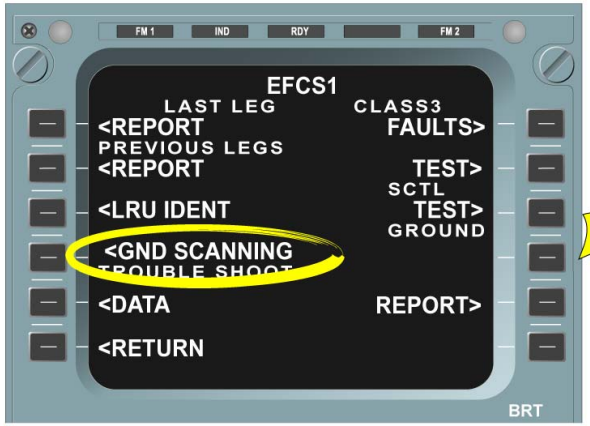
MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

G9409341 - GAUT0T0 - FM27B1000000001

Check that the F/CTL STAB FAULT message appears.



Do the BITE test of the EFCS (GND SCANNING)

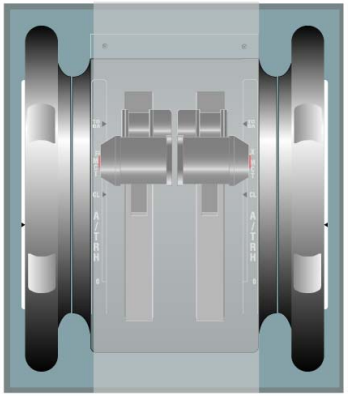


MCDU MESSAGE

- FCPC 1(2CE1)/WRG/THS ACTR CIRCUIT BREAKER TO FCPC1, when the circuit breaker for THS actuator motor 1 is open,
- THS ELEK MDL(1CS)/FCPC2 (2CE2)/RLY(6CS2/23CS2), when the circuit breakers for THS actuactor motor 2 are open,
- THS ELEK MDL(1CS)/FCPC3 (2CE3)/RLY(6CS3), when the circuit breaker for THS actuator motor 3 are open.

Push the PRIM 2 and 3 and check that the pitch trim control wheels automatically move to the 4° position.

Trim wheels return to 4 degrees up position.



PITCH TRIM CONTROL WHEELS

MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

G9409341 - GAUT0T0 - FM27B1000000001

Depressurize the hydraulics systems.

MEL/DEACTIVATION - DEACTIVATION OF THE THS ACTUATOR ELECTRICAL MOTOR

FLIGHT CONTROLS LINE MAINTENANCE BRIEFING (2)

MAINTENANCE TIPS

EXTENSION OF THE SPOILERS FOR MAINTENANCE

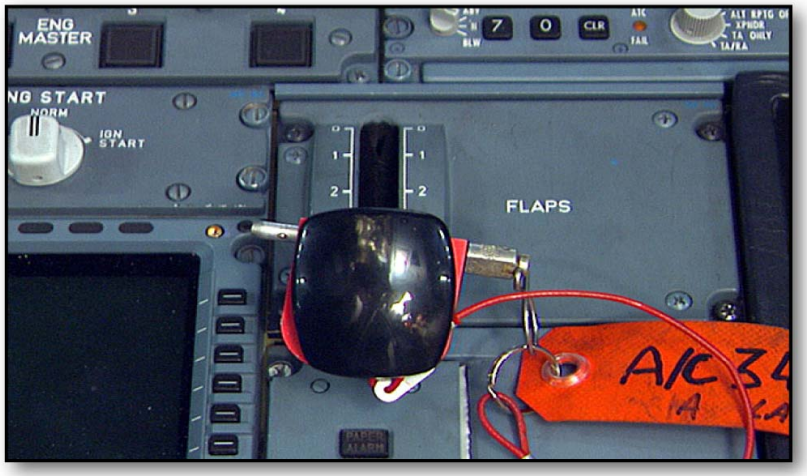
To get access to the spoiler actuators, extend the flaps and secure the selector with the locking tool. If the flaps cannot be extended access is done by removing the applicable access panel. Place warning notices in the cockpit to prevent flight control operation.
To extend the spoilers for maintenance, install the spoiler maintenance key in the maintenance device and turn it in the "M" position.
Move the spoiler to the extended position with your hand and secure it with the safety collar-spoiler. If no other servicing tasks have to be completed the area can be closed.

NOTE: The spoiler can move on its own with its weight.

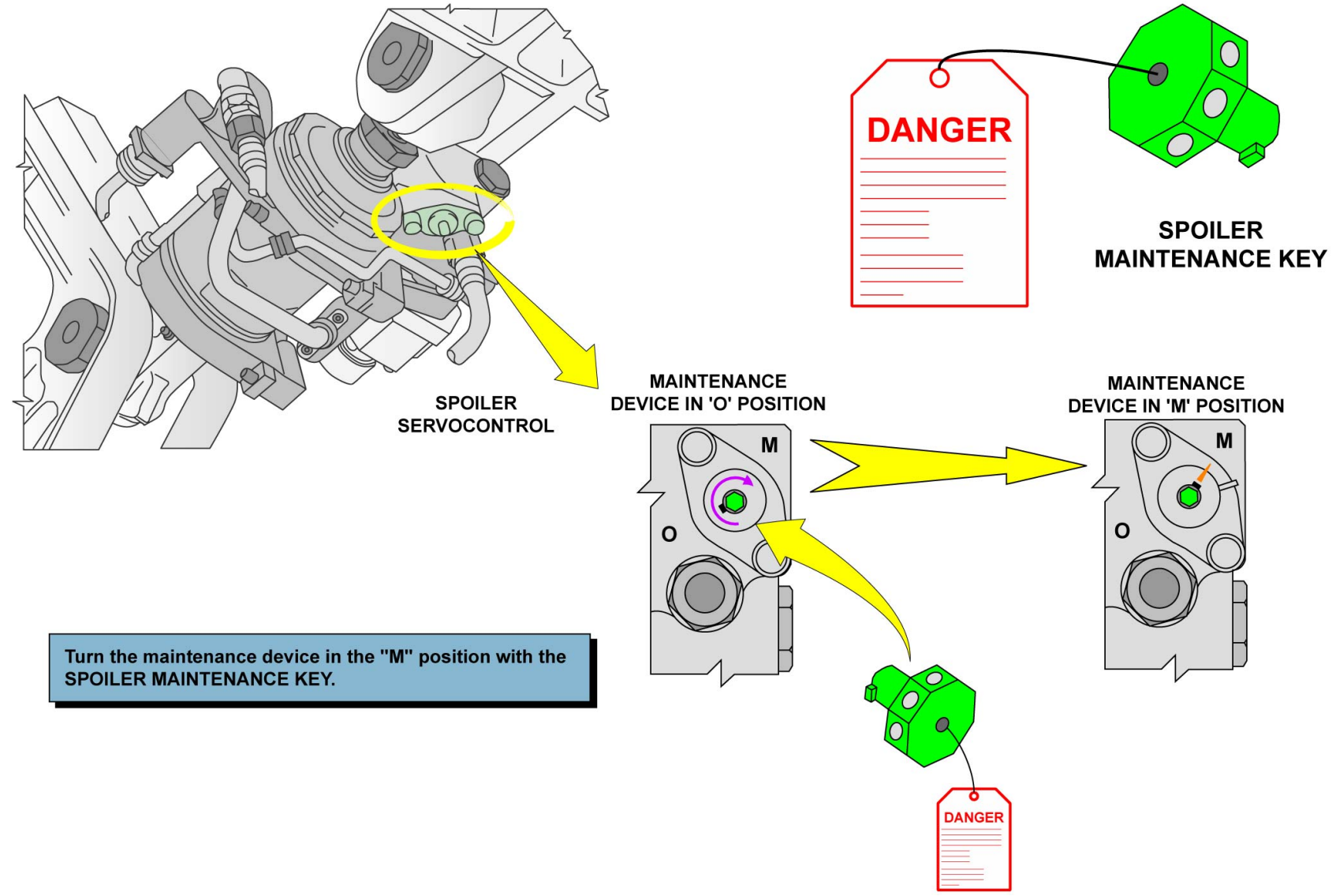
G9409341 - GAUT0T0 - FM27B1000000001

Extension of the flaps on the ground.

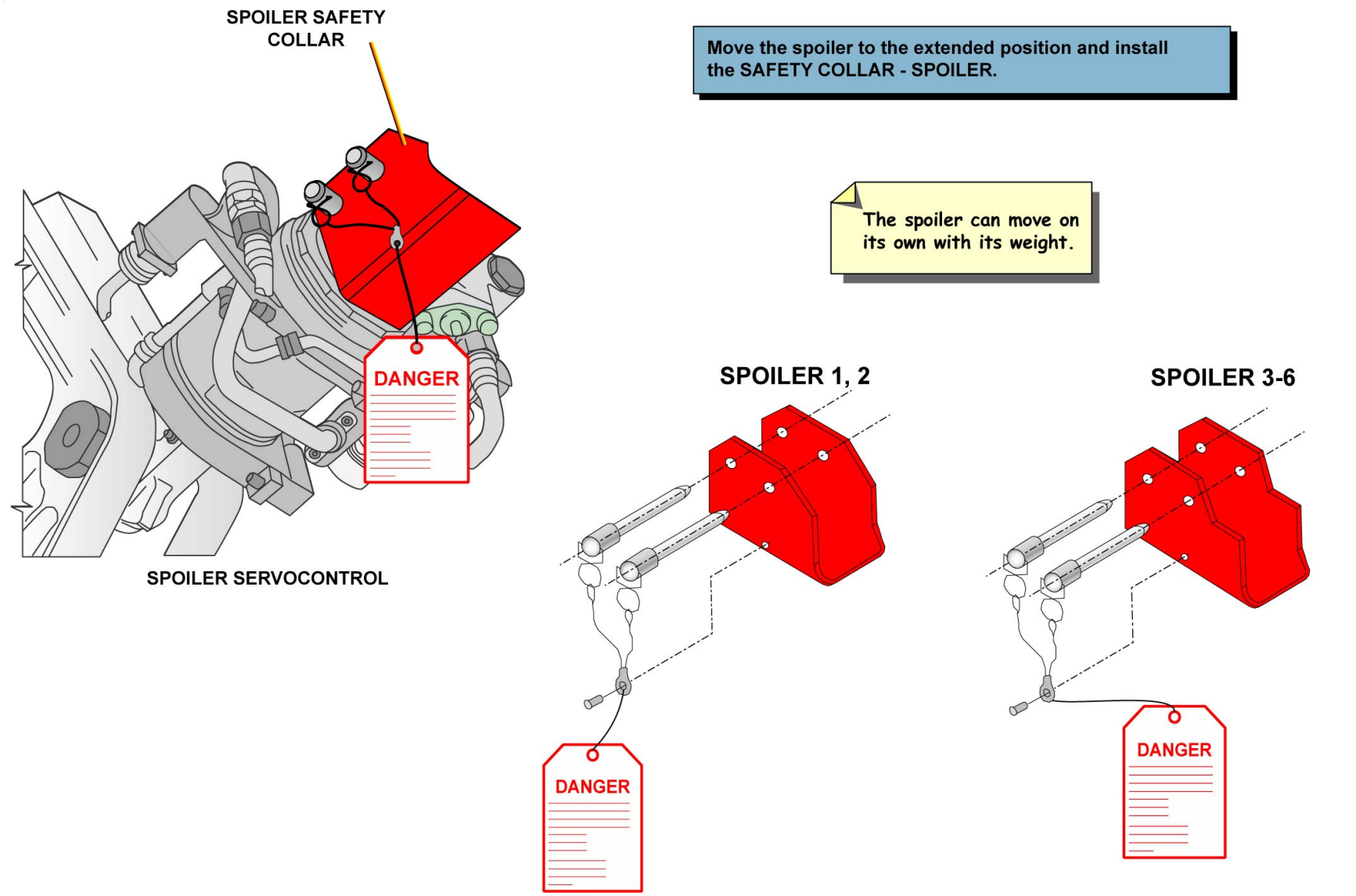
Install a warning notice in the cockpit.



MAINTENANCE TIPS - EXTENSION OF THE SPOILERS FOR MAINTENANCE



MAINTENANCE TIPS - EXTENSION OF THE SPOILERS FOR MAINTENANCE


SPOILER SAFETY COLLAR
Move the spoiler to the extended position and install the SAFETY COLLAR - SPOILER.
The spoiler can move on its own with its weight.
DANGER
SPOILER SERVOCONTROL
SPOILER 1, 2
SPOILER 3-6
DANGER
DANGER

MAINTENANCE TIPS - EXTENSION OF THE SPOILERS FOR MAINTENANCE

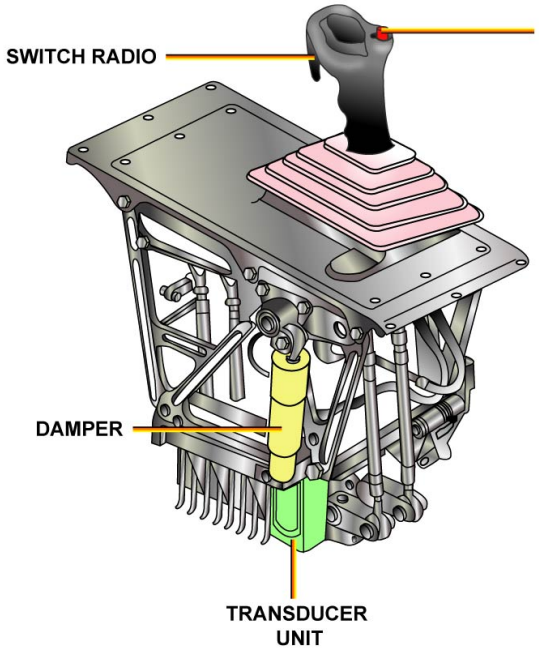
SIDE STICK D/O (3)

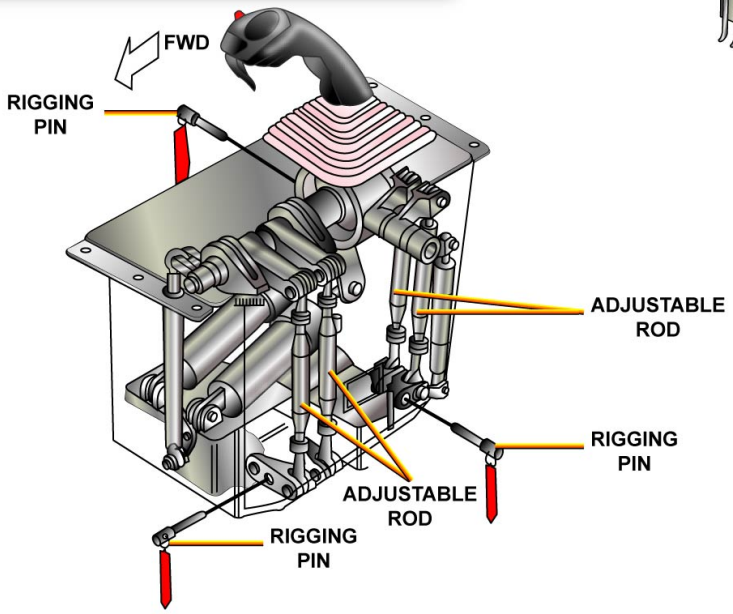
GENERAL

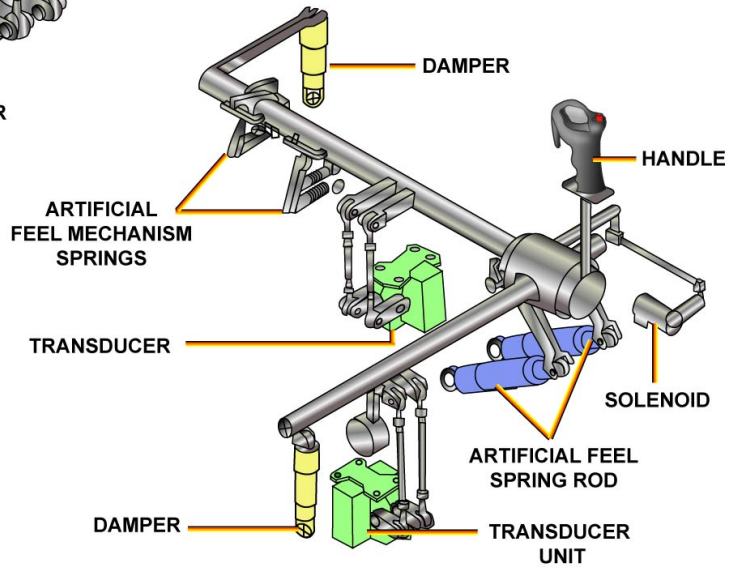
The main function of the side sticks is to transmit to the Electrical Flight Control System (EFCS) the lateral and longitudinal manual control orders in the form of electrical signals, depending on the position of the hand grip. It also generate the related artificial feel loads using spring rods, springs and dampers.
In autopilot mode, a solenoid is energized in order to keep the side sticks in the neutral position. By doing this, the solenoid provides a higher load level in order to prevent any unwanted switching to the manual control mode, while keeping the possibility to override the autopilot if required.
A thermoformed polycarbonate casing houses the mechanical assembly to prevent the penetration of foreign matter, which could jam the moving parts.
Two identical transducer units are associated to each computer, one for roll control, another one for pitch control. A transducer unit comprises sets of potentiometers driven by a duplicate mechanism and connected to the EFCS computers via connectors. Ring pins can be installed for adjustment

WARNING: During handling, make sure that the side stick assembly stays in vertical position. There is a risk of skydrol leakage from dampers.

G9409341 - GAUT0T0 - FM27DB000000001


SWITCH RADIO
TAKE OVER AND
PRIORITY P/BSW
DAMPER
TRANSDUCER
UNIT


FWD
RIGGING
PIN
ADJUSTABLE
ROD
RIGGING
PIN
ADJUSTABLE
ROD
RIGGING
PIN


DAMPER
HANDLE
ARTIFICIAL
FEEL MECHANISM
SPRINGS
TRANSDUCER
SOLENOID
ARTIFICIAL FEEL
SPRING ROD
DAMPER
TRANSDUCER
UNIT

GENERAL

SIDE STICK D/O (3)

SIDESTICK AND PRIORITY LOGIC

Sidesticks, one on each lateral console, are used for manual pitch and roll control. They are springloaded to neutral. When the autopilot is engaged, a solenoid-operated detent locks both sidesticks in the neutral position. If the pilot applies a force above a given threshold (5daN in pitch, 3.5 daN in roll), the autopilot disengages and the sidestick unlocks and sends an input to the computers. The hand grip includes 2 P/Bs: An autopilot disconnect/sidestick priority P/B and a push-to-talk button. Sidestick priority logic: When only one pilot operates the sidestick, his demand is sent to the computers. When the other pilot operates his sidestick, in the same or opposite direction, both pilot inputs are algebraically added. The addition is limited to single-stick maximum deflection.

NOTE: In the event of simultaneous inputs on both sidesticks (2° deflection off the neutral position in any direction), the two green SIDE STICK PRIORITY lights, on the glareshield, come on and the "DUAL INPUT" voice message activates.

A pilot can deactivate the other sidestick, and take full control by pressing and keeping pressed his takeover P/B. For latching the priority condition, it is recommended that the takeover P/B be pressed for more than 40 seconds. The takeover pushbutton can then be released without losing priority. However, a deactivated sidestick can be reactivated at any time, by momentarily pressing either takeover P/B. If both pilots press their takeover P/Bs, the last pilot to press their P/B will have priority.

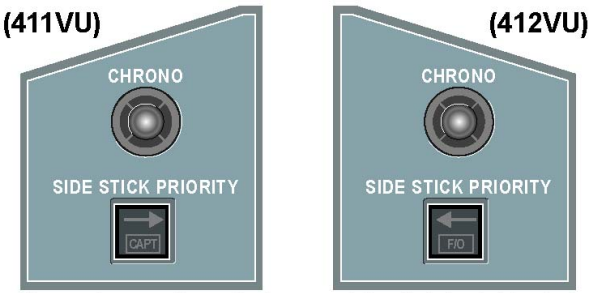
NOTE: If an autopilot is engaged, any action on a takeover P/B will disengage it.

In a priority situation, a red light will come on, in front of the pilot whose sidestick is deactivated. A green light will come on, in front of the pilot who has taken control, if the other sidestick is not in the neutral position (to indicate a potential and unwanted control demand).

NOTE: If one stick is deactivated on ground, at takeoff thrust application, the takeoff «CONFIG» warning is triggered.

G9409341 - GAUT0T0 - FM27DB000000001

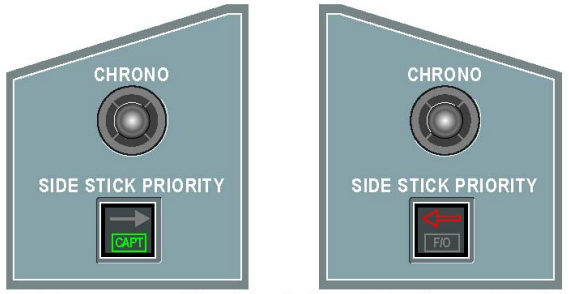
(411VU) (412VU)



Normal operation: Only one sidestick is deflected.

+ "DUAL INPUT" Aural message

The Captain and First Officer inputs are algebraically summed. The maximum resulting input is limited to a full deflection input of a single sidestick.



+ "PRIORITY LEFT" Aural message

The Captain presses his sidestick pushbutton, while the First Officer moves his sidestick. The Captain gains the priority.

SIDESTICK AND PRIORITY LOGIC

ROLL D/O (3)

GENERAL

The ailerons in conjunction with the roll spoilers (spoilers2 to 6) do the aircraft roll control.
The rudder (Yaw control) carries out automatically the turn coordination and the dutch roll damping.
In MANUAL CONTROL MODE:
the side stick roll transducers send roll inputs to the Flight Control Primary Computers (FCPCs) and Flight Control Secondary Computer (FCSCs).
In AUTOPILOT CONTROL MODE:
the Flight Management Guidance and Envelope Computers (FMGECs) send guidance orders to the FCPCs only.
When Autopilot (AP) is engaged the side sticks are locked by solenoid operated load threshold device. If a pilot overrides such a force threshold, he will cause the AP disengagement.
The master computer (normally FCPC1 computation part) calculates the roll deflection orders.
and sends it to all the FCPCs and FCSCs (execution part). These computers achieve the servoing of aileron and roll spoiler servocontrols.
The Flight Control Computers need signals from the Air Data/Inertial Reference Units (ADIRUs) to establish the aircraft response (roll attitude, roll rate...),
AT HIGH SPEED (Vc higher than 190 kts), in clean configuration (slats/flaps retracted) the outboard ailerons are servoed to zero.
In autopilot mode and in some failure cases, the outboard ailerons are used up to 300 kts.
AILERONS DROOP:
This function is used to deflect symmetrically the ailerons downwards when the flaps are extended.

AILERONS-PRESENTATION

Each aileron is actuated by two interchangeable electro-hydraulic servocontrols powered by different hydraulic systems.
The servocontrols on the inboard aileron and the servocontrols on the outboard aileron are not interchangeable.

AILERONS-NORMAL OPERATION

Each servocontrol is connected to:
- 2 computers for the inboard aileron (1 FCPC and 1FCSC),
- 1 computer for the outboard aileron (1 FCPC or 1 FCSC),
for servoloop and to satisfy the servoloop reconfiguration order shown by the reconfiguration arrows.
The aileron servocontrols have two control modes, active and damping.
In normal configuration, the outer servocontrol of each aileron is in active mode, the inner servo control is in damping mode.

AILERONS-ABNORMAL OPERATIONS

HYDRAULIC OR ELECTRIC FAILURE:
- if a servocontrol in active mode is not hydraulically powered or not electrically controlled anymore, the faulty servocontrol falls in the damping mode and the adjacent one becomes active.
- if both servocontrols of an aileron are faulty, both servocontrols are in damping mode which prevents the appearance of flutter.

AILERONS/SPOILERS-SPECIAL CASES

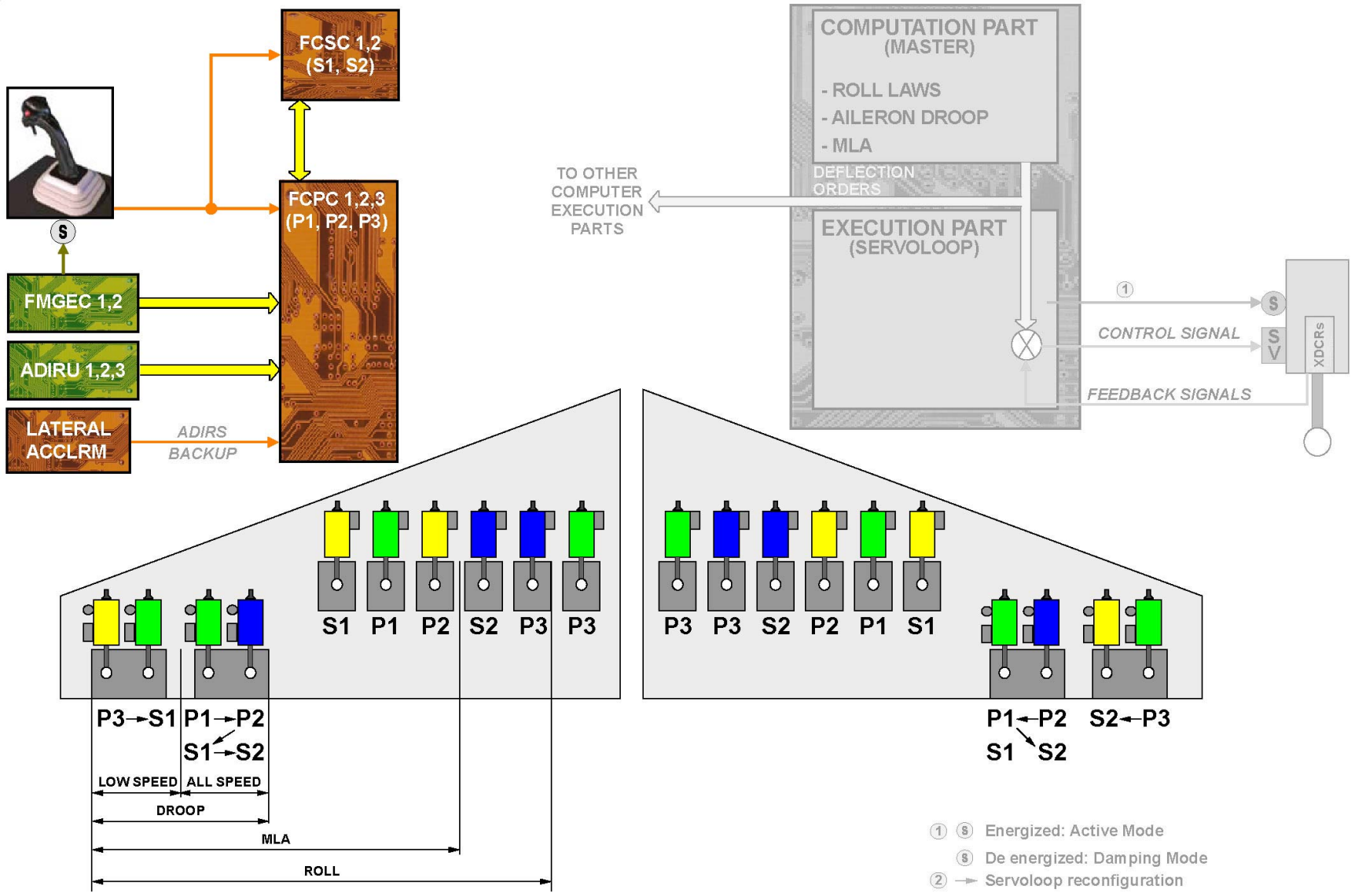
. When the Ram Air Turbine (RAT) is extended, the outboard ailerons are not used, the related servocontrols are switched to the damping mode in order to minimize the hydraulic consumption.
On ground, with hydraulic systems depressurized, it is acceptable to see the ailerons droop due to their weight.
MLA MANEUVER LOAD ALLEVIATION:

The function of the MLA is to redistribute the lift over the wing to relieve structural loads on the outer wing surfaces and so reducing the bending moment of the wing. The MLA function raises symmetrically the ailerons and the spoilers 4,5,and 6.The deflection is proportional to load factor in excess of 2 g.
An elevator demand is simultaneously applied to compensate the pitching moment induced by the spoilers and the ailerons.

ROLL SPOILERS-GENERAL

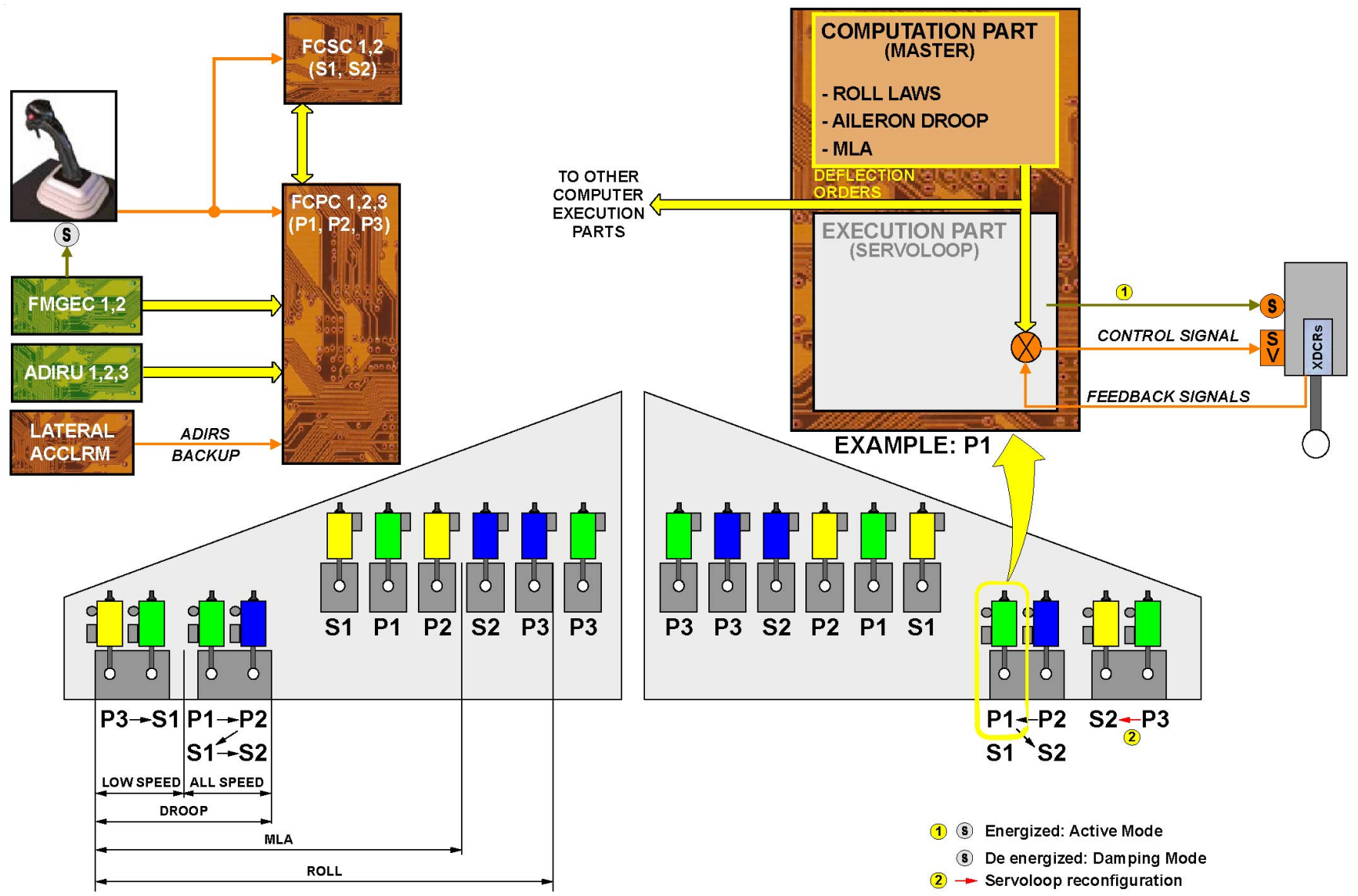
Each spoiler is actuated by an electro-hydraulic servocontrol. All the servocontrols are of the same size, but have different lengths of travel. The Spoiler servocontrol principles will be detailed later in the modules Primary Control Speed Brake and Lift Dumping.

G9409341 - GAUT0T0 - FM27D3000000003



GENERAL ... ROLL SPOILERS-GENERAL

G9409341 - GAUT0T0 - FM27D3000000003



GENERAL ... ROLL SPOILERS-GENERAL

G9409341 - GAUT0T0 - FM27D3000000003

ROLL D/O (3)

AILERON SERVO CONTROL PRINCIPLES

ACTIVE MODE

In the active mode, the aileron servo-control actuator is pressurized and the solenoid valve energized by the computer.

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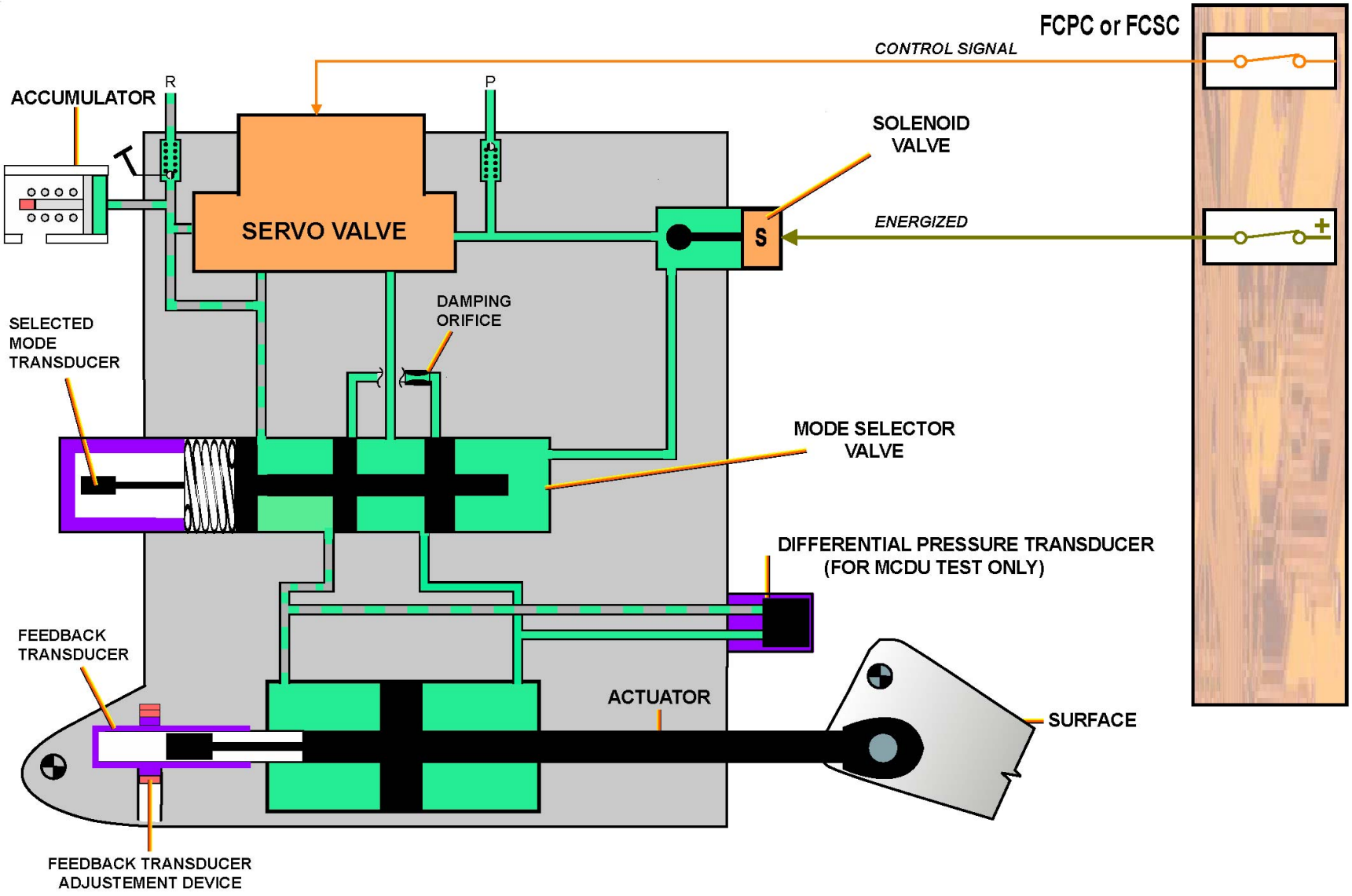


AILERON SERVO CONTROL PRINCIPLES - ACTIVE MODE

G9409341 - GAUT0T0 - FM27D3000000003

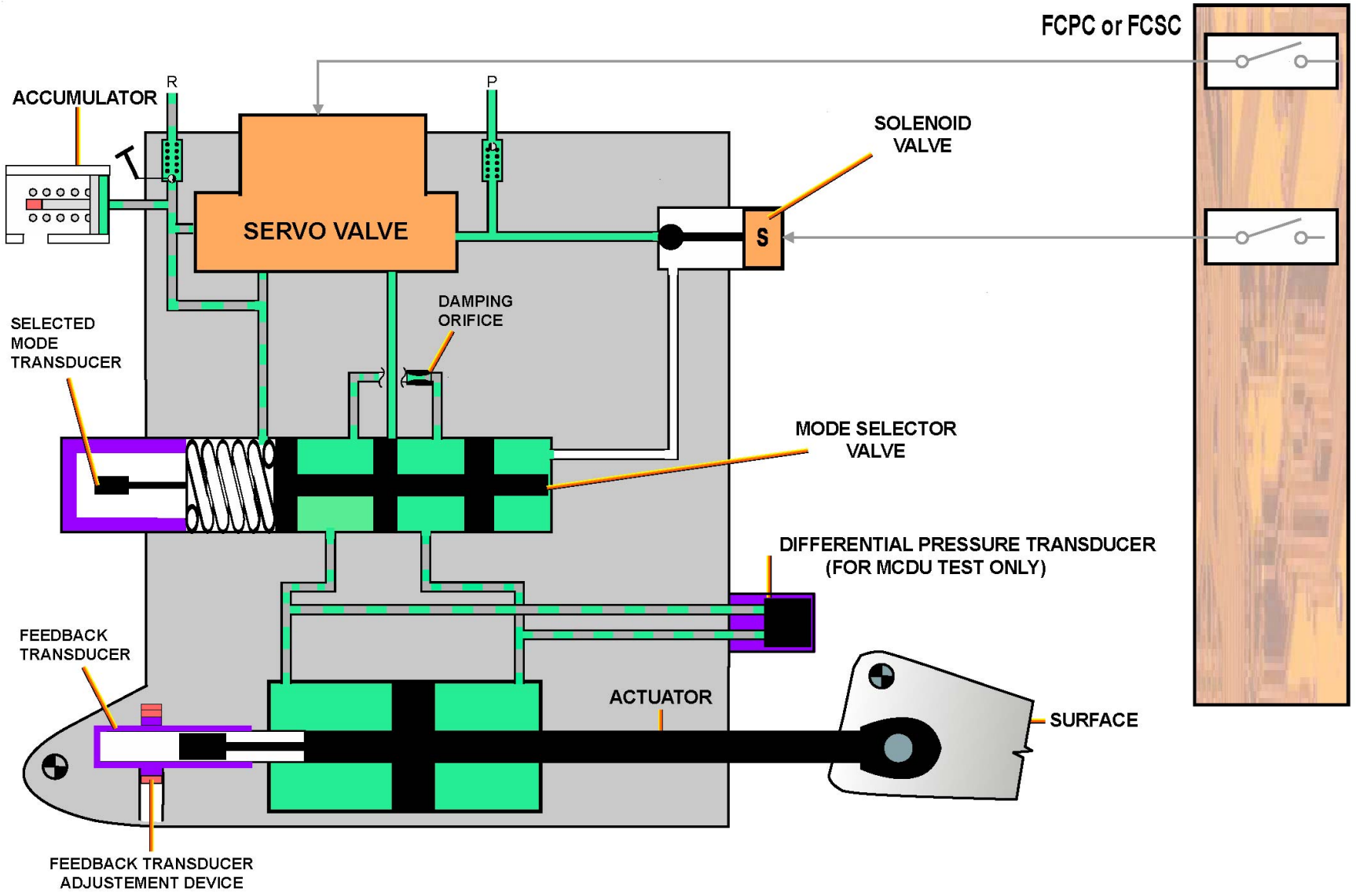
ROLL D/O (3)

AILERON SERVO CONTROL PRINCIPLES (continued)

DAMPING MODE

If the solenoid valve is de-energized or the servo-control actuator is not pressurized, the servo control actuator is in damping mode. In damping mode, the actuator follows the control surface movements.

G9409341 - GAUT0T0 - FM27D3000000003



AILERON SERVO CONTROL PRINCIPLES - DAMPING MODE

G9409341 - GAUT0T0 - FM27D3000000003

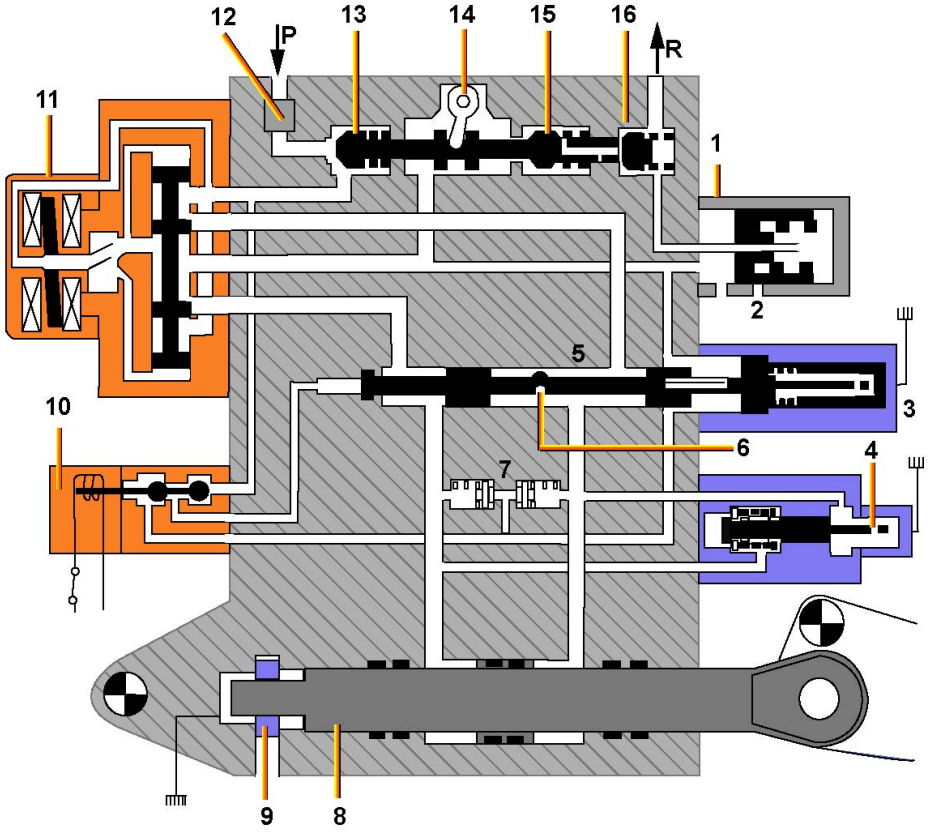
ROLL D/O (3)

AILERON SERVO CONTROL PRINCIPLES (continued)

TEST/ADJUSTMENT

The servo control design enables the test of the accumulator and internal valves using the accumulator sight indicator and a test finger.
The test finger is manually operated by using an hexagon socket wrench.
The adjustment is possible by acting on the position feedback device.

G9409341 - GAUT0T0 - FM27D3000000003



1 ACCUMULATOR
2 ACCUMULATOR SIGHT INDICATOR
3 MODE SELECTOR VALVE POSITION TRANSDUCER
4 DIFFERENTIAL PRESSURE TRANSDUCER
5 MODE SELECTOR VALVE
6 DAMPING RESTRICTION
7 ANTICAVITATION VALVES
8 FEEDBACK TRANSDUCER
9 FEEDBACK TRANSDUCER ADJUSTEMENT DEVICE
10 SOLENOID VALVE
11 SERVO VALVE
12 FILTER
13 INLET ALOCKING VALVE
14 TEST FINGER
0 = ZERO
1 = LEAK CHECK
2 = DISCHARGE
15 RETURN BLOCKING VALVE
16 RETURN RELIEF VALVE

AILERON SERVO CONTROL PRINCIPLES - TEST/ADJUSTMENT

G9409341 - GAUT0T0 - FM27D3000000003

PITCH D/O (ELEVATOR) (3)

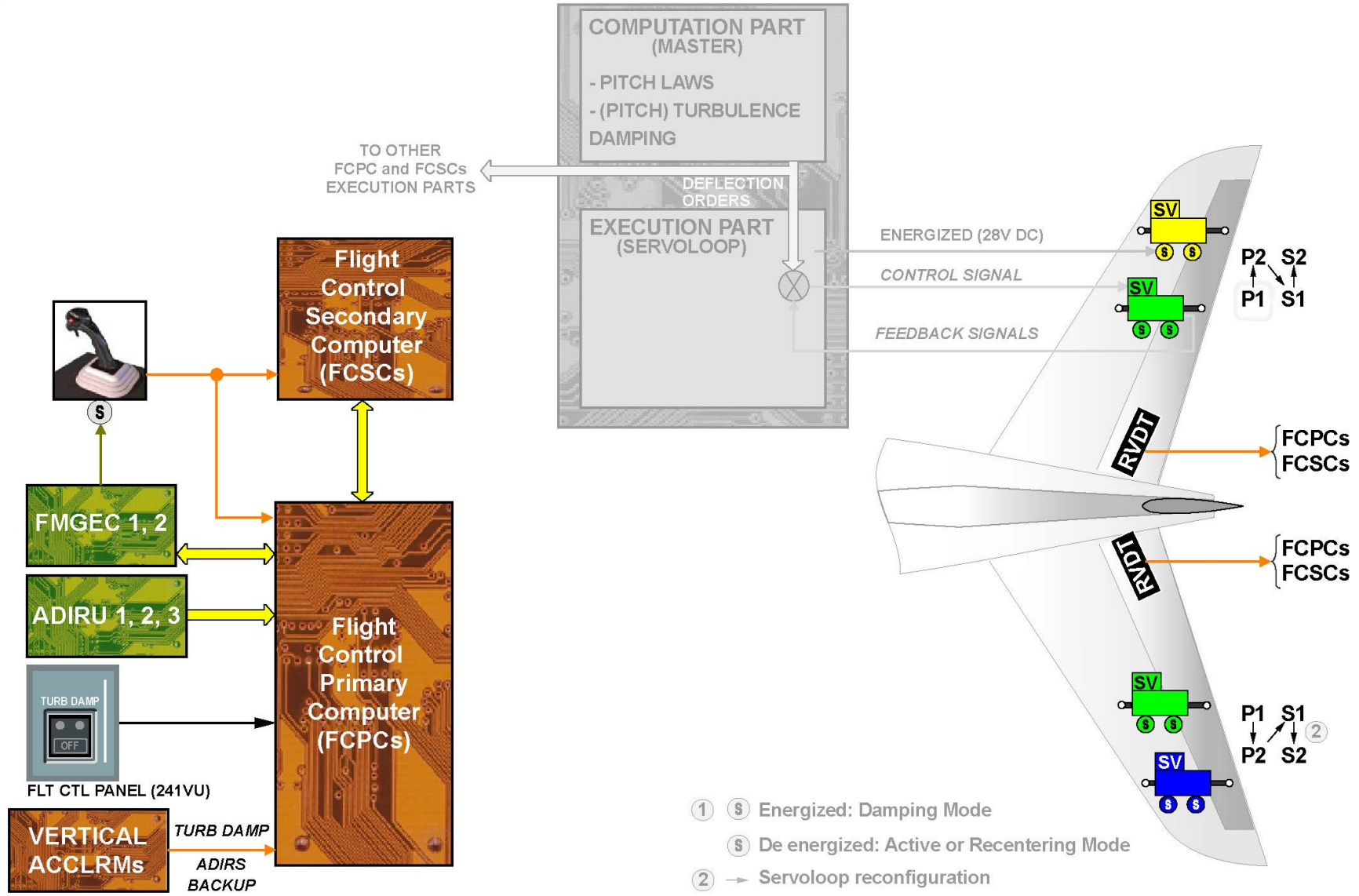
GENERAL

The pitch control is achieved by two elevators and Trimmable Horizontal Stabilizer (THS). The elevators are used for short-term pitch control, the THS for long-term pitch control.
In MANUAL CONTROL MODE:
the pitch is controlled from the side stick pitch transducers which send electrical signals to the Flight Control Primary Computers (FCPCs) and Flight Control Secondary Computers (FCSCs).
In AUTOPILOT (AP) CONTROL MODE,
the Flight Management Guidance and Envelope Computers (FMGECs) send guidance orders to the FCPCs only.
When the AP is engaged, the side sticks are locked by a solenoid-operated load threshold device energized by the FMGECs.
The master computer (normally FCPC 1 computation part) calculates the elevators and the THS deflection orders and sends them to all the computer execution parts that achieve the servoing of the elevator servocontrols and THS actuator.
The Flight Control Computers also need signals from:
- Air Data Reference Units (ADIRUs) to establish the A/C response (pitch attitude, load factor, etc)
- two vertical accelerometers for turbulence damping function and in case of ADIRU failure.

ELEVATORS PRESENTATION

Each elevator is actuated by two interchangeable hydraulic servocontrols.
Each servocontrol has three operating modes:
active mode, damping mode and re-centering mode.

G9409341 - GAUT0T0 - FM27D2000000003



GENERAL & ELEVATORS PRESENTATION

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (ELEVATOR) (3)

ELEVATORS NORMAL OPERATION

Each elevator servocontrol is connected to two computers (one FCPC and one FCSC).
In the normal configuration, the inboard servocontrol is in active mode while the outboard is in damping mode.
FCPC 1 having the servo-loop control priority:
- sets its dedicated servocontrol in active mode and ensures the servoloop control,
- commands the damping mode on the adjacent servocontrol (one solenoid valve (S) energized).

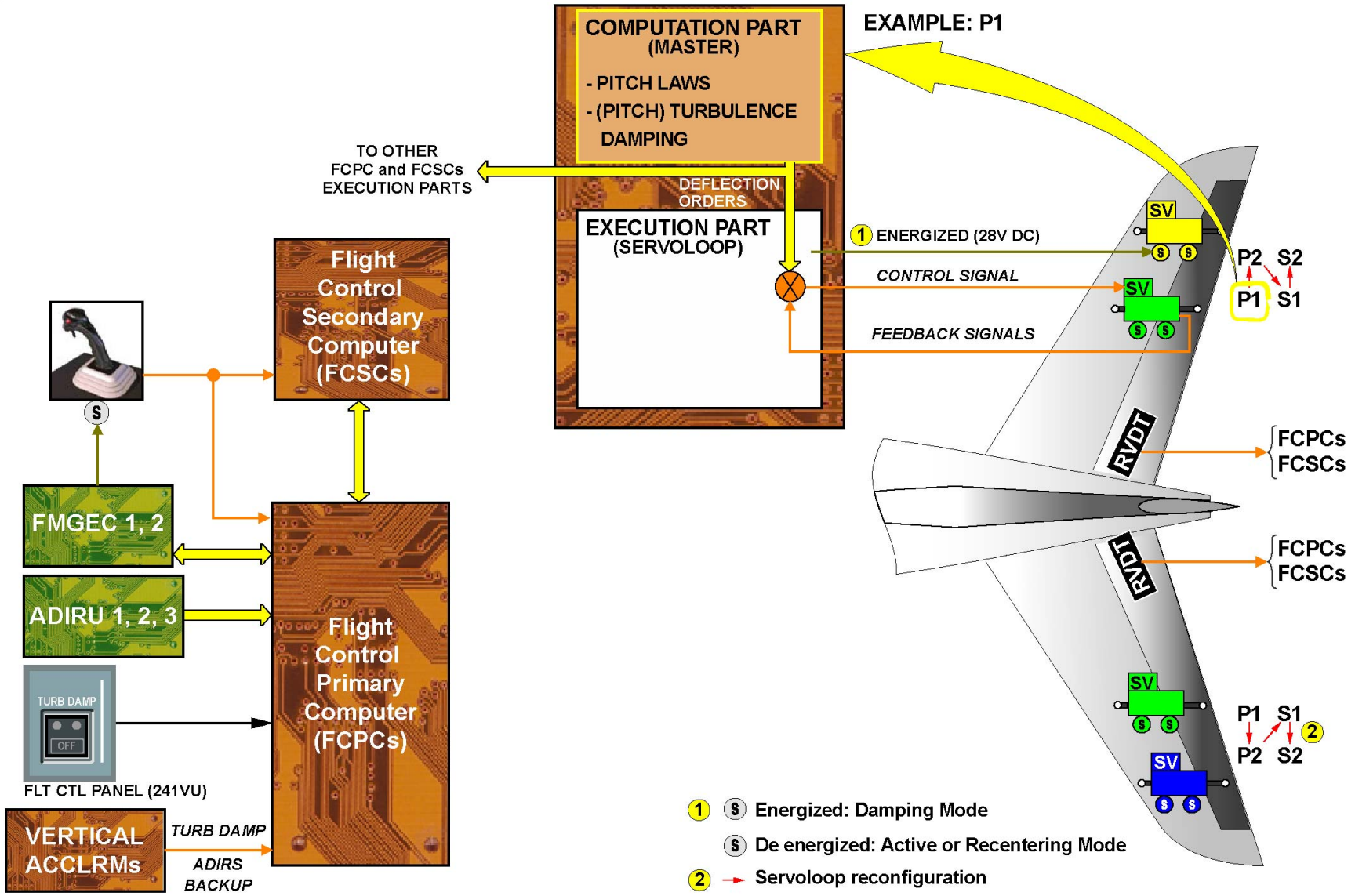
For the elevator servolooping computation the computers need to acquire:
- the elevator surface position,
- the elevator servocontrol piston position.

This information is sent by servocontrol transducers (XDCRs) units and the surface position transducer (RVDT).
In the event of large deflection demands, the two servo-controls can become active to avoid the saturation of one servocontrol.

ELEVATORS ABNORMAL OPERATIONS

HYDRAULIC OR ELECTRICAL FAILURE
If a servocontrol being in active mode is either not hydraulically powered or not electrically controlled anymore,
the faulty servocontrol falls in damping mode and the adjacent one becomes active according the servoloop reconfiguration.
If both servocontrols of one elevator are depressurized, both servocontrols are in damping mode which prevents fluttering.
When P1, P2, S1 and S2 are no longer able to control their dedicated servocontrol (ie: inputs missing, electrical failure, etc...), the servocontrols fall in re-centering mode.

G9409341 - GAUT0T0 - FM27D2000000003



ELEVATORS NORMAL OPERATION & ELEVATORS ABNORMAL OPERATIONS

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (ELEVATOR) (3)

ELEVATORS SERVO CONTROL PRINCIPLES

ACTIVE MODE

When the elevator servo control is in the active mode, both solenoid valves are de-energized. The servovalve is controlled by its dedicated computer and the solenoid valves by other computers.
The servo control is pressurized.

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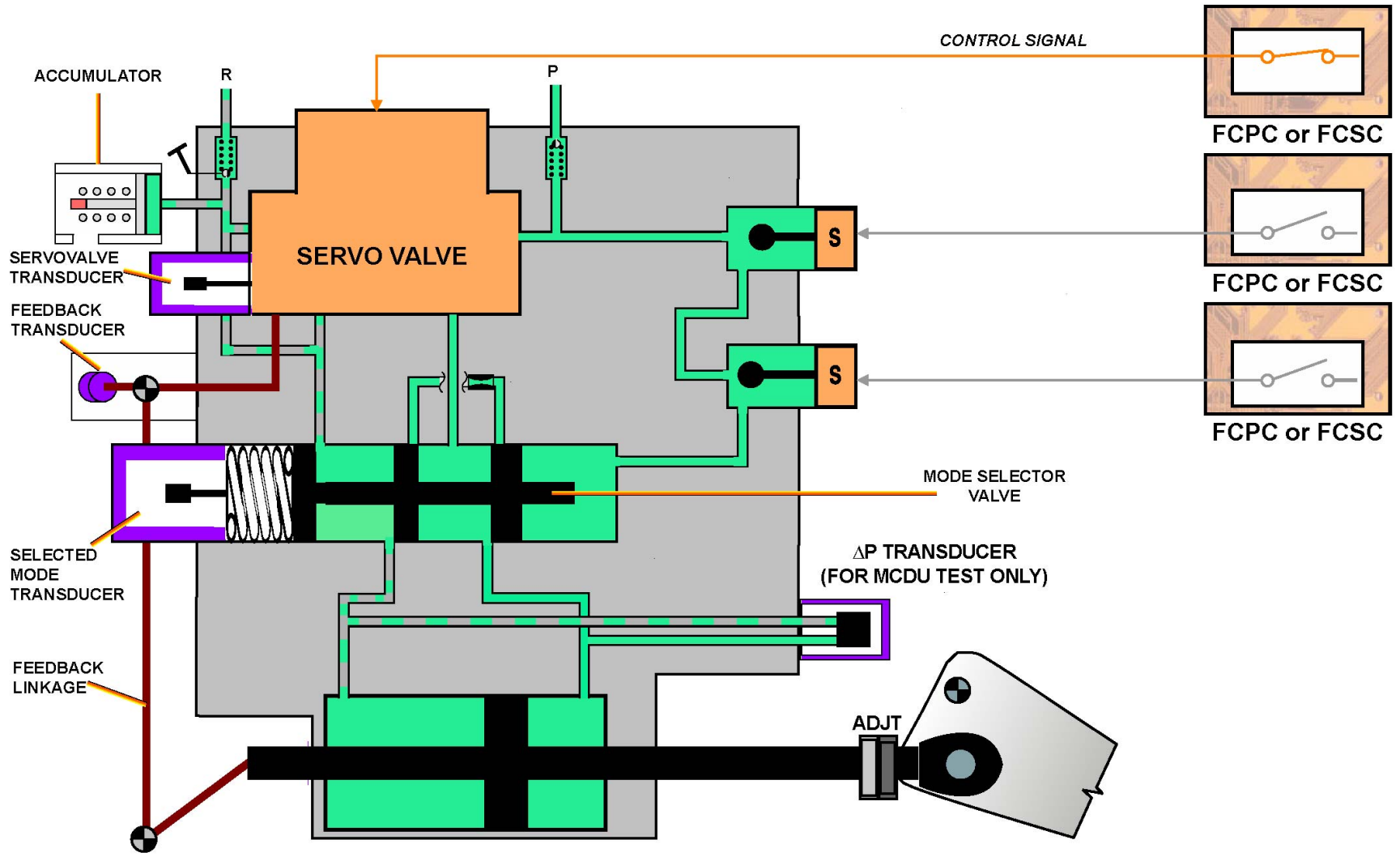

ELEVATORS SERVO CONTROL PRINCIPLES - ACTIVE MODE

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (ELEVATOR) (3)

ELEVATORS SERVO CONTROL PRINCIPLES (continued)

DAMPING MODE

In damping mode, one of the two solenoid valves is energized by the computer controlling the adjacent servocontrol.
The servo control is also considered in damping mode if not hydraulically pressurized.

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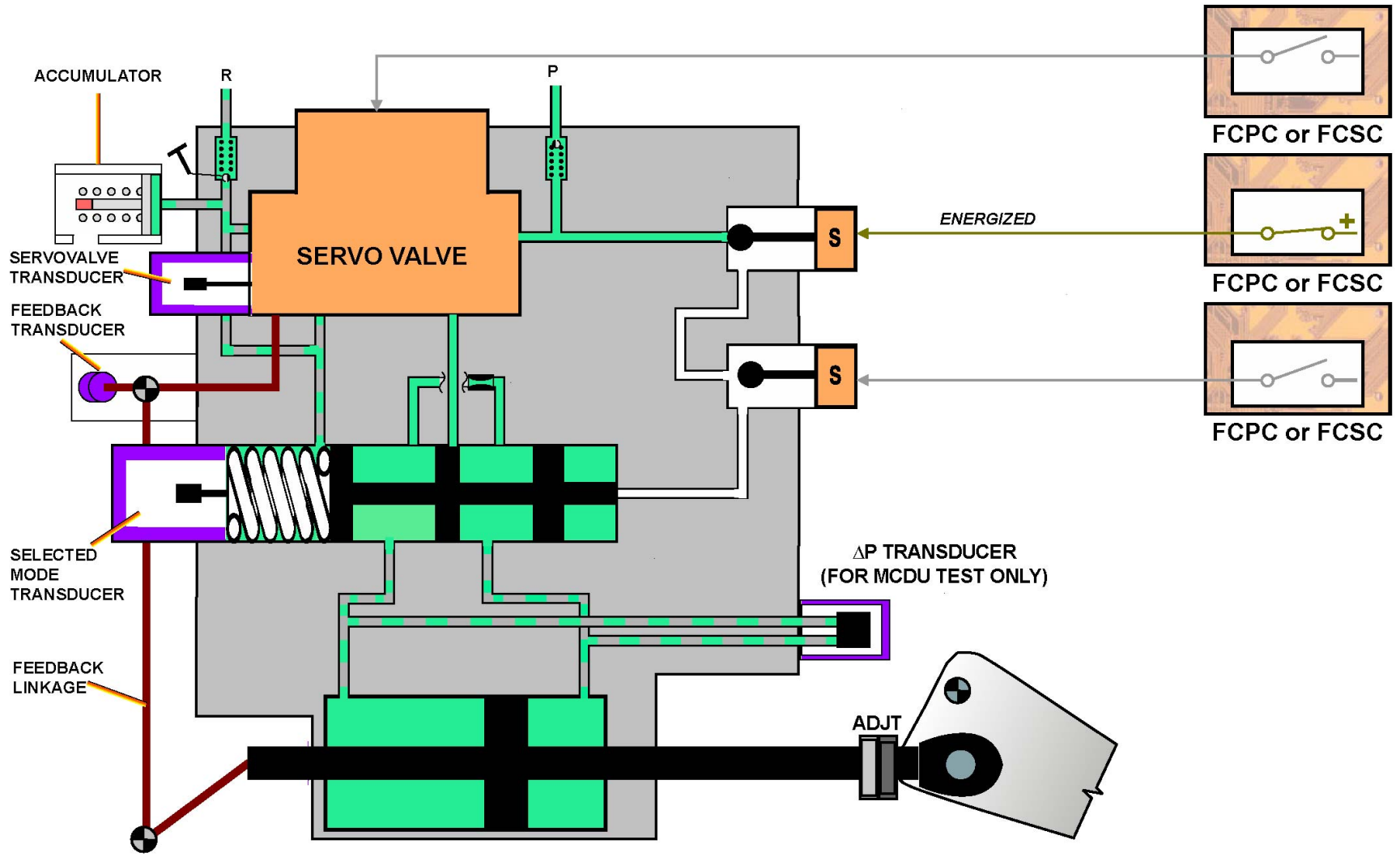

ELEVATORS SERVO CONTROL PRINCIPLES - DAMPING MODE

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (ELEVATOR) (3)

ELEVATORS SERVO CONTROL PRINCIPLES (continued)

RE-CENTERING MODE

When the elevator servo control is in the re-centering mode, both solenoid valves are de-energized and no command signals are sent to the servo valve. The servocontrol is hydraulically powered.
Thanks to the mechanical feedback linkage, the servo control is mechanically controlled in its neutral position.

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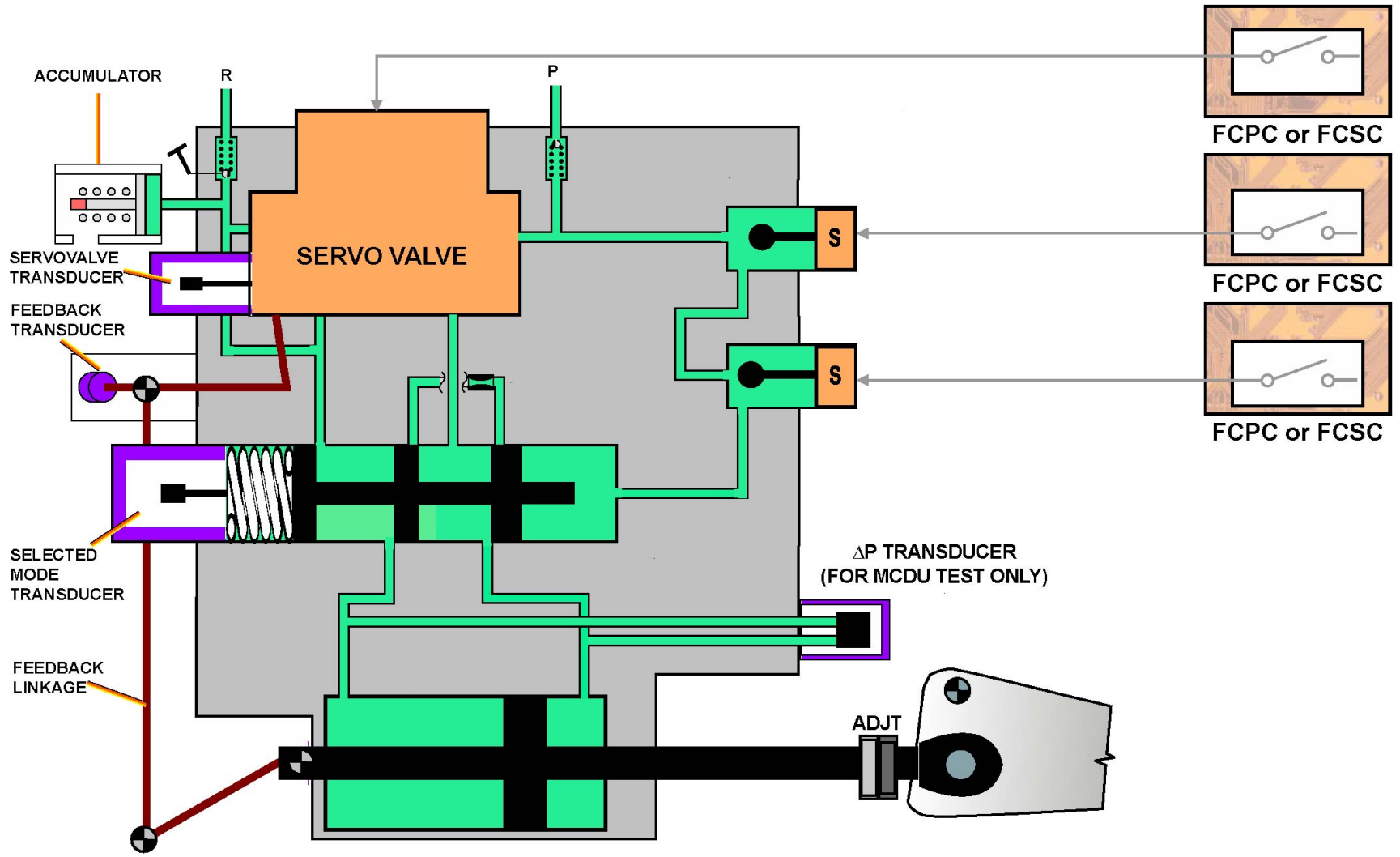

ELEVATORS SERVO CONTROL PRINCIPLES - RE-CENTERING MODE

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (ELEVATOR) (3)

ELEVATORS SERVO CONTROL PRINCIPLES (continued)

TEST/ADJUSTMENT

The servo control design enables the test of the accumulator, the inlet blocking valve, the return blocking valve and the return relief valve using the accumulator sight indicator and a test finger.
The test finger is manually operated by using an hexagon socket wrench (see maintenance manual).
Rigging of the servocontrol is done by adjusting the piston rod length.

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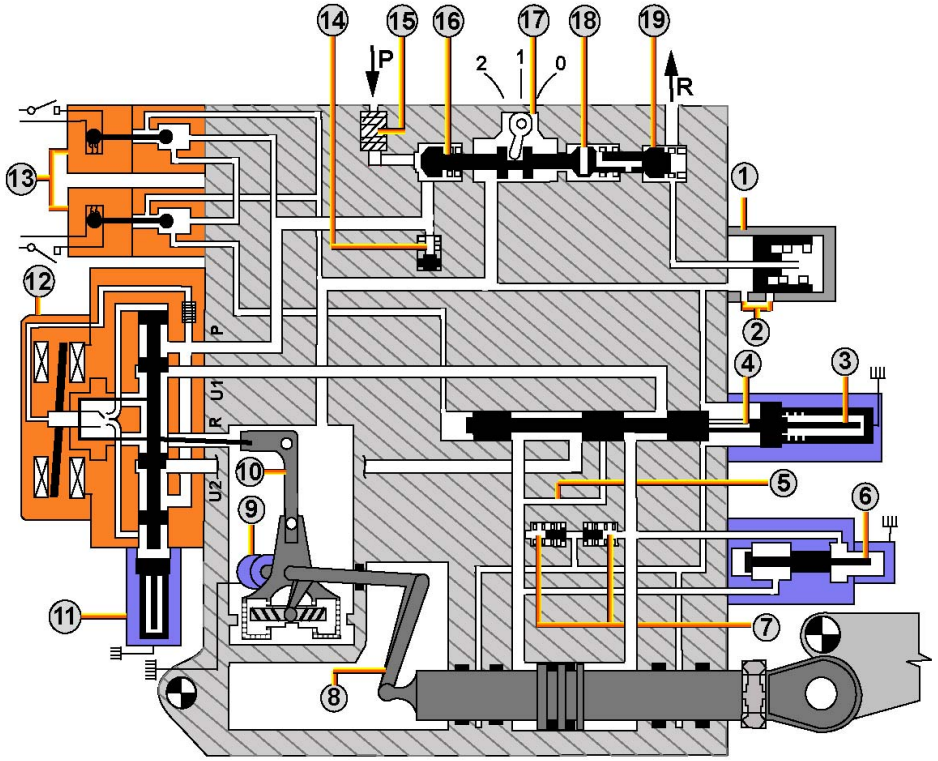

1 ACCUMULATOR
2 ACCUMULATOR SIGHT INDICATOR
3 MODE SELECTOR VALVE POSITION TRANSDUCER
4 MODE SELECTOR VALVE
5 DAMPING ORIFICE
6 DIFFERENTIAL PRESSURE TRANSDUCER
7 ANTICAVITATION VALVES
8 FEEDBACK LINKAGE
9 FEEDBACK TRANSDUCER
10 MECHANICAL INPUT
11 SERVOVALVE TRANSDUCER
12 SERVOVALVE
13 SOLENOID VALVES
14 TEST CHECK VALVE
15 FILTER
16 INLET BLOCKING VALVE
17 TEST FINGER
0 = ZERO
1 = LEAK CHECK
2 = DISCHARGE
18 RETURN BLOCKING VALVE
19 RETURN RELIEF VALVE

ELEVATORS SERVO CONTROL PRINCIPLES - TEST/ADJUSTMENT

G9409341 - GAUT0T0 - FM27D2000000003

PITCH D/O (THSA) (3)

GENERAL

In conjunction with the two elevators, a Trimmable Horizontal Stabilizer (THS) is used to control the pitch of the aircraft.

TRIMMABLE HORIZONTAL STABILIZER (THS)

The THS is attached to a ball nut which is actuated by a ball screw jack and powered by two hydraulic motors linked through a differential.
The ball screw jack has a fail safe design. It consists of a double load path.

THS MECHANICAL CONTROL

The THS mechanical control can be used:
- on ground, for maintenance or take off trim setting.
- in flight, as a standby system if automatic control (autotrim) is not available.

When an input is made, the feedback differential gearbox comparator compares the input with the movement of the ball screw jack (feedback gear). The difference between the two mechanical signals is shown as the control differential output.
The control differential output moves the control valve.
The control valve opens and lets hydraulic fluid go into the hydraulic motors. Both hydraulic motors operate at the same time and drive the ball screw jack, which in turn, moves the THS.
During operation with Electric pump, when the flow rate is low, the pressure maintaining device keeps the pressure-off brakes released.
When the THS actuator gets to the demanded position the feedback gear moves the control differential input, which decreases the control valve opening. The control valve closes and stops the hydraulic flow to the motors. The ball screw jack stops at the commanded position.

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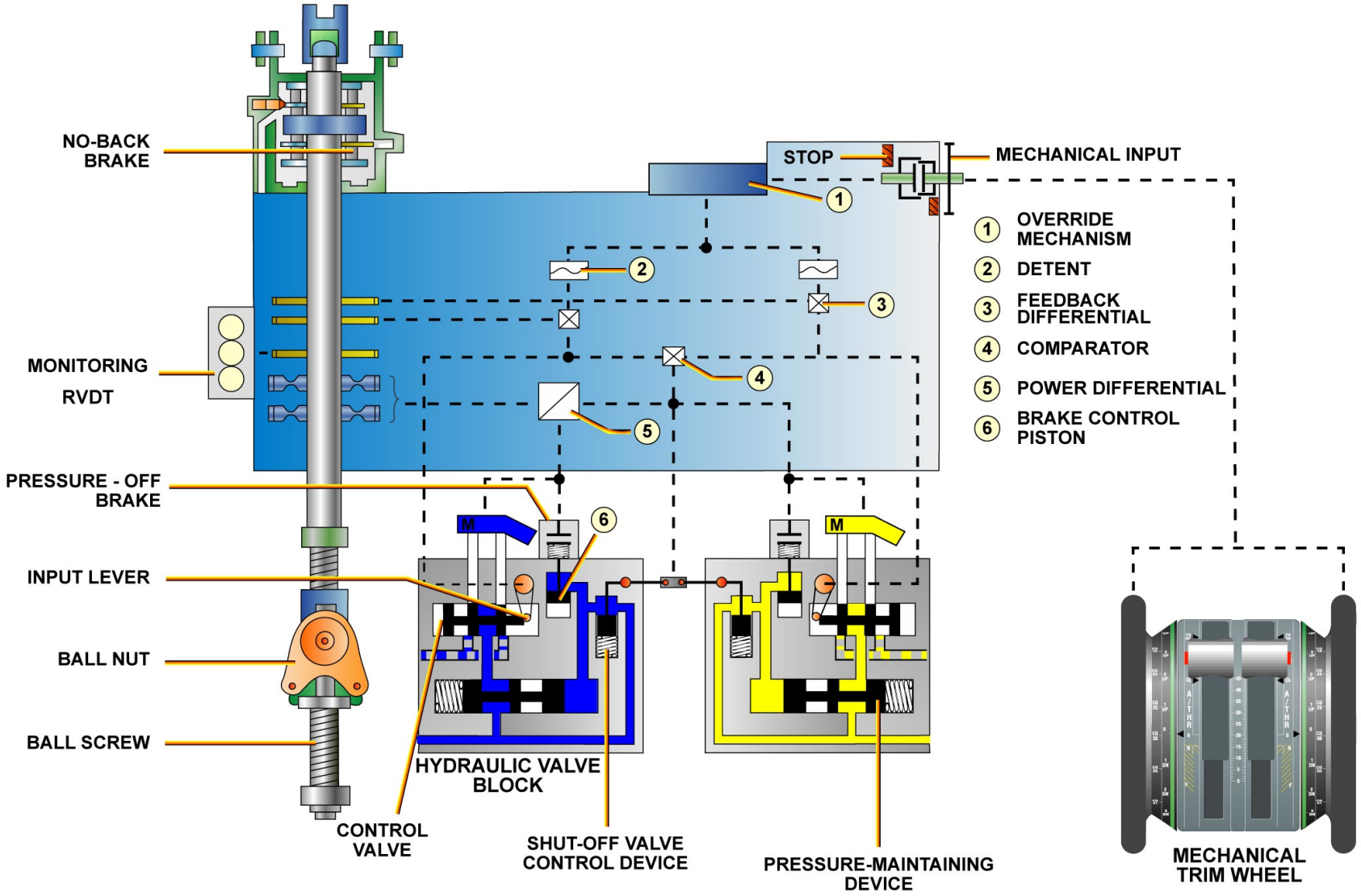

GENERAL ... THS MECHANICAL CONTROL

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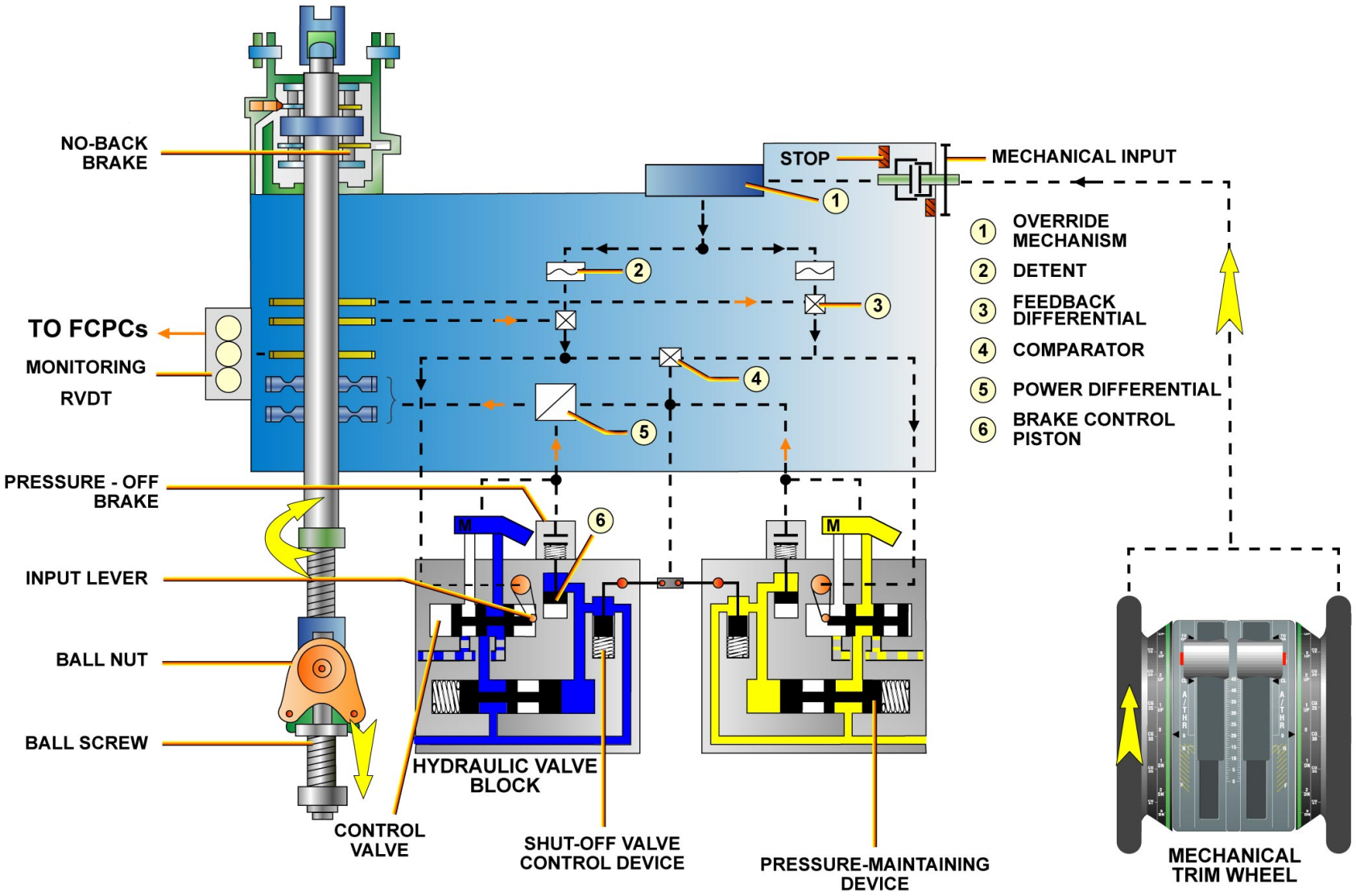

GENERAL ... THS MECHANICAL CONTROL

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PITCH D/O (THSA) (3)

THS ELECTRICAL CONTROL

The Pitch Trim Actuator (PTA) consists of three Digital Electronic Modules (DEMs) and their associated electrical motors.
An override mechanism, which is installed in the PTA, makes sure that the mechanical control through the trim wheels cancels the electrical control.
The FCPCs transmit a deflection order to the pitch trim actuator. Among the FCPCs able to control the THS, the computer having the servoloop control priority transmits the deflection order to its associated digital electronic modules. This digital electronic module controls its associated electrical motor. The two other motors are in standby.
For the THS servolooping computation, the computers need to acquire the pitch trim actuator output position and the screw jack position. This information is sent by transducer units, which are of the RVDT type. The electrical control achieves the autotrim function. The command Rotary Variable Differential Transducers (RVDTs) transmit the PTA output position to the DEMs. The monitor RVDTs transmit the ball screw position to the FCPCs monitor channels.
When a manual command is made with the trim wheels, the override mechanism gives priority over the electrical command from the FCPCs. It mechanically disconnects the PTA output from the mechanical input (via electro-magnetic clutch) and also operates the overriding detection switches which in turn signal the FCPC's to stop any electrical command from the FCPC's.
ONE HYDRAULIC SUPPLY FAILURE:
If one hydraulic supply to the THS actuator becomes unserviceable, the related Pressure Off Brake (POB) is applied. The POB stops and holds the hydraulic motor shaft. The power differential operates at a reduced speed. The THS actuator is driven at half speed by the motor that stays in operation.
DUAL HYDRAULIC SUPPLY FAILURE:
If there is a complete loss of hydraulic power to the THS actuator, the POBs and the no-back brake operate. They hold the THS actuator ball screw jack in its last signalled position.
THS CONTROL VALVE JAMMING:
If the control valve stops between the fully open and the fully closed positions:
- the control valve opening in the defective circuit lets the hydraulic motor continue to operate,
- the ball screw jack continues to operate and moves the feedback gear after the serviceable control valve reaches its neutral position,
- the comparator which is connected to both control valves operates,
- the comparator piston operates both shutoff valves,
- the shutoff valves stop the hydraulic supply to both hydraulic motors,
- the POBs stop the hydraulic motors and the ball screw-jack stops.

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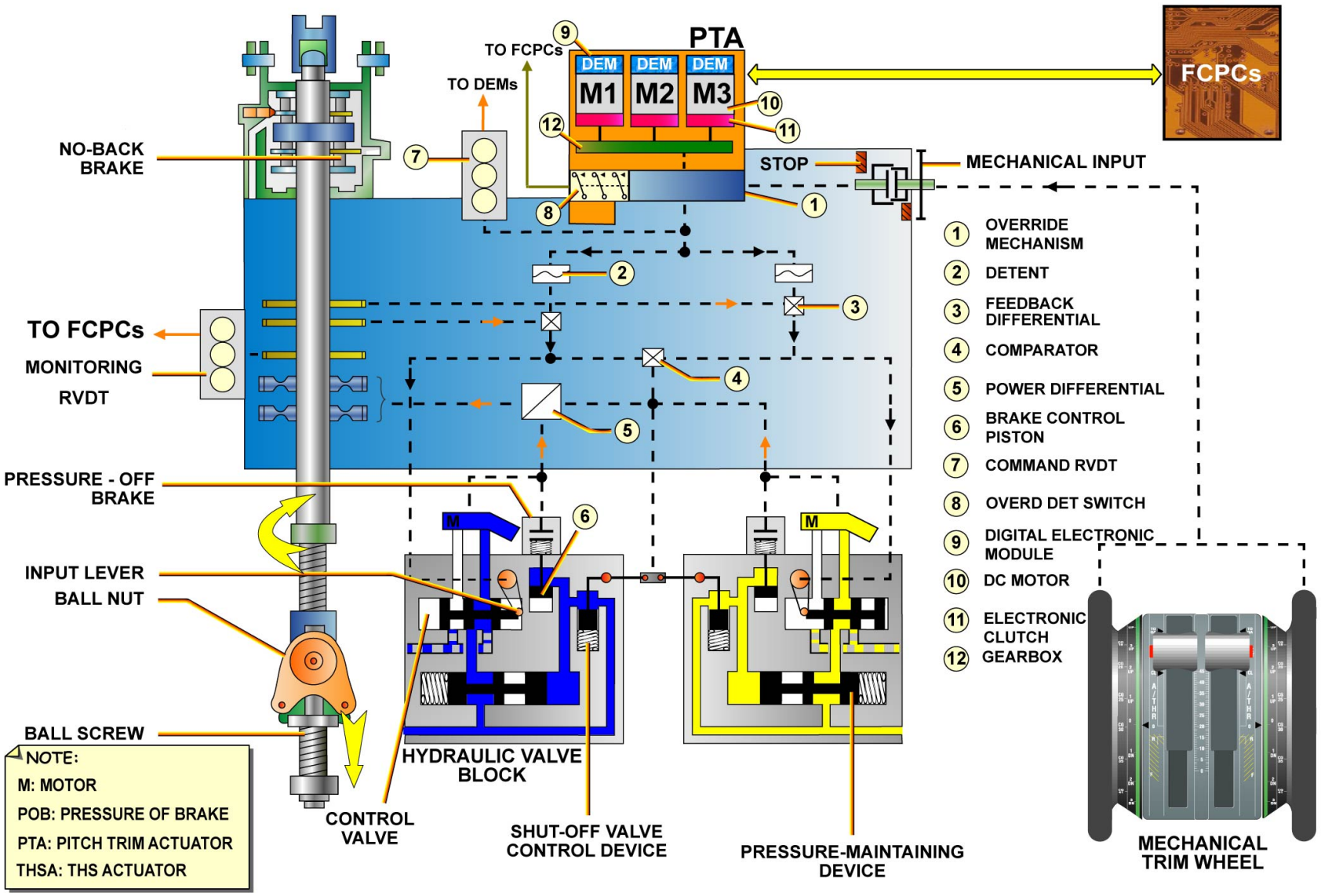

THS ELECTRICAL CONTROL

G9409341 - GAUT0T0 - FM27DC000000002

PITCH D/O (THSA) (3)

OPERATION

The computers also need the aircraft response from the Air Data Inertial Reference Units (ADIRUs).
For the computation of the surface deflection orders, the FCPCs acquire additional information.
The data are from:
- accelerometer units,
- radio altimeters.

The FCDC receives the THS and elevators positions and sends them to the EIS for display on the Flight Controls (F/CTL) ECAM page.

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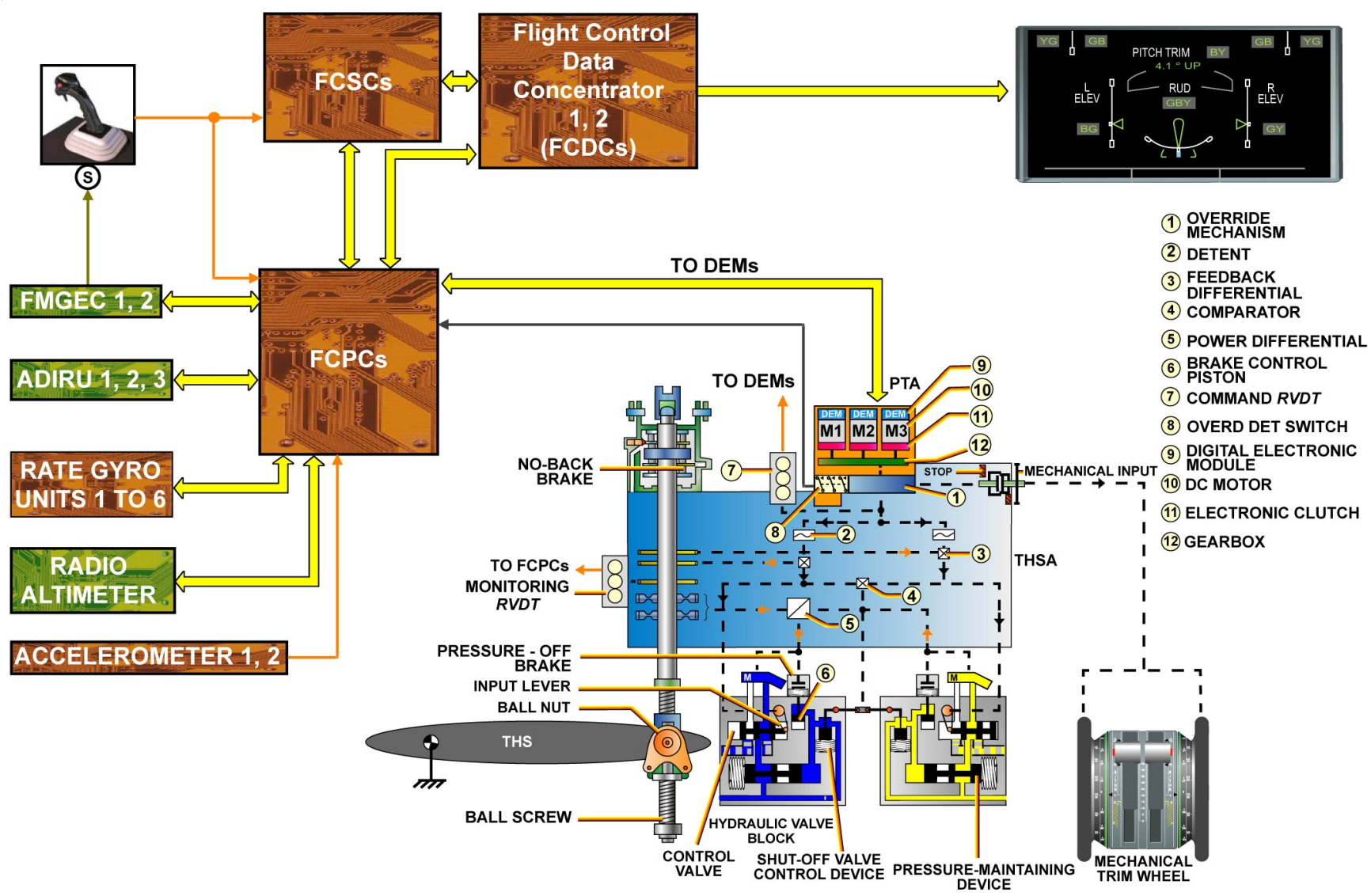

OPERATION

G9409341 - GAUT0T0 - FM27DC000000002

PITCH D/O (THSA) (3)

CHECKABLE SHEAR PIN DESCRIPTION

The lower attachment of the THSA is composed of a permanently loaded Primary Load Path (PLP) and an unloaded Secondary Load Path (SLP).
If the PLP fails, a Checkable Shear Pin (CSP) is installed on the lower attachment of the THSA to give an indication of an SLP engagement.
The CSP is composed of:
- a piston,
- an internal spring,
- 2 switches assigned to the two RVDTs monitoring,
- a check button.

In case of SLP engagement, the spring pops out the piston and the two switches are triggered.
Then, the RVDT circuit is opened so that the FCPCs detect the failure, the THSA electrical control is inhibited and a failure message is displayed on the ECAM.
Following an SLP engagement, the CSP cannot be reset to prevent from inadvertent operation. Maintenance action is required to trouble shoot the THSA before the next flight.
To verify the correct operation of the CSP:
- push the check button in order to activate the switches and to display the related ECAM warning messages,
- then, release the check button to get the switches deactivated and the messages disappeared.

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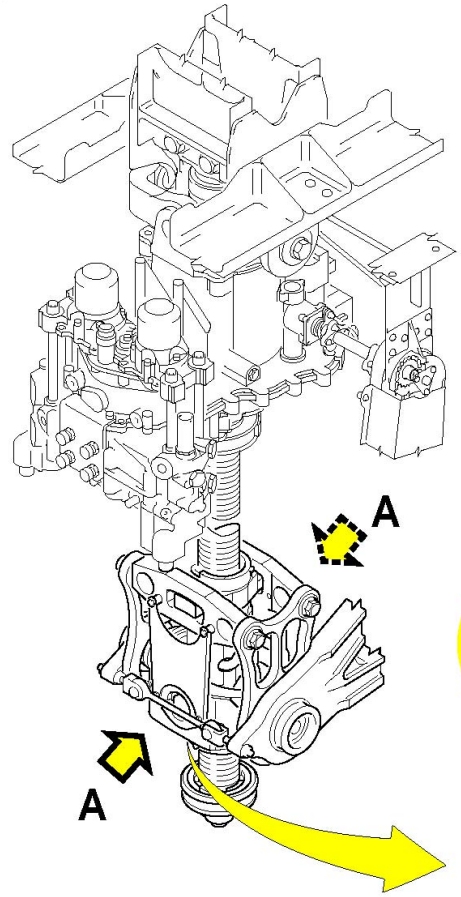
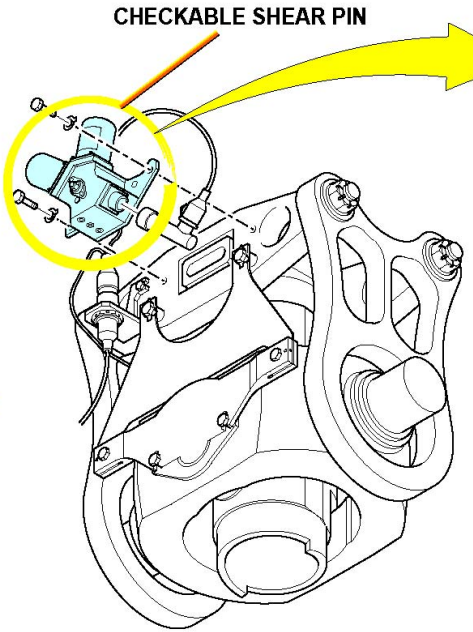
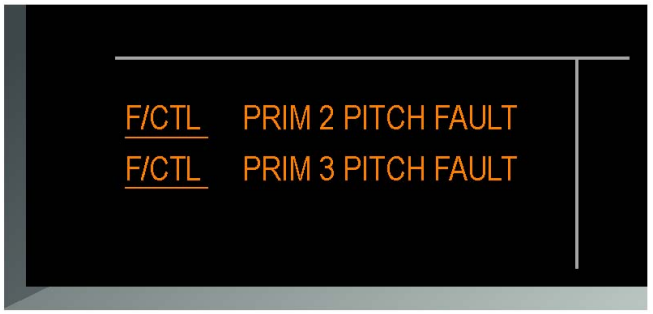
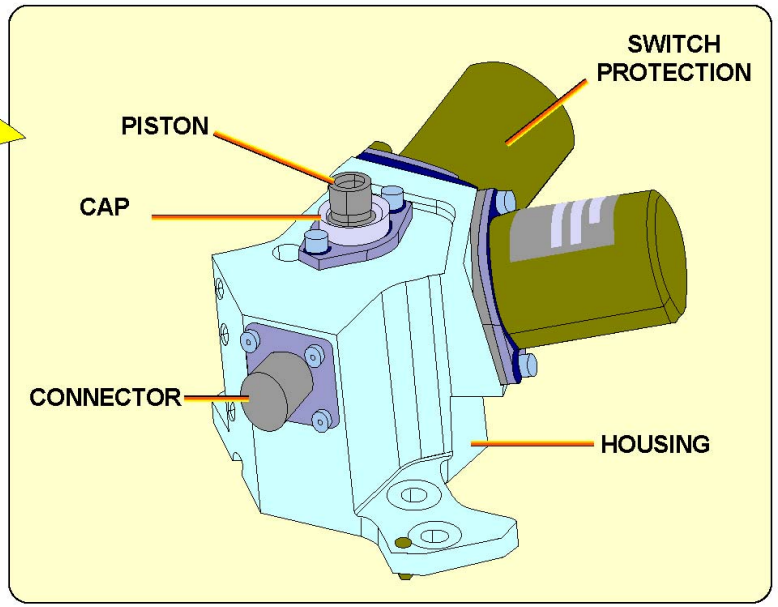




VIEW FROM A



WARNING MESSAGES ON EWD



TWO CHECKABLE SHEAR PIN ARE INSTALLED AT THE BOTTOM PART OF THE THSA.

CHECKABLE SHEAR PIN DESCRIPTION

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YAW D/O (3)

GENERAL

The rudder gives the yaw control.
The rudder can be controlled (rudder pedals) and trimmed (rudder trim control panel) manually.
It also carries out automatically the dutch roll damping and the turn coordination.
The rudder is electrically controlled by the Flight Control Computers and hydraulically actuated by three synchronized servocontrols.
In case of total loss of the normal servoing, an electrical backup (BPSs and BCM) also permits the yaw control (see page 17/23).

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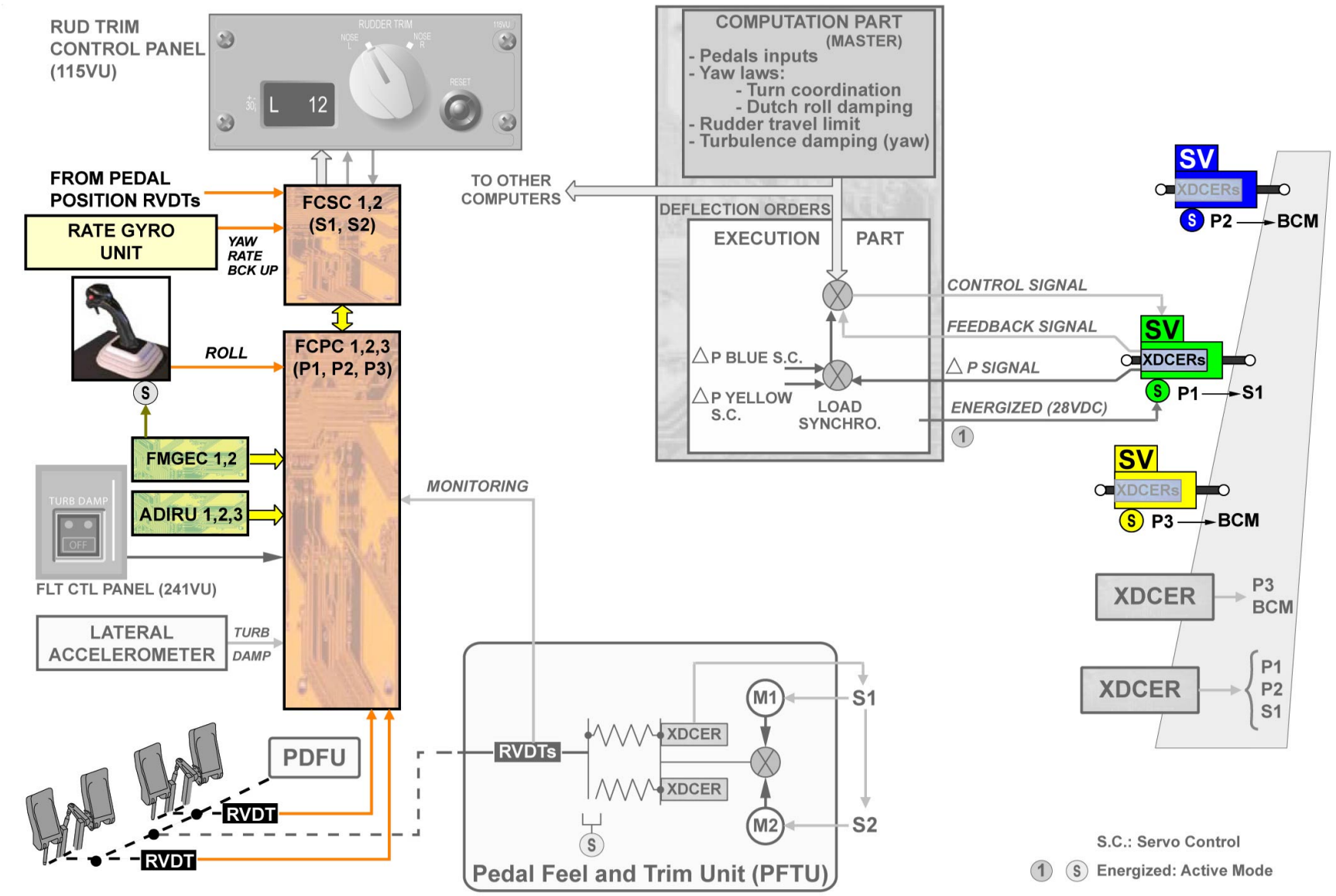
RUD TRIM CONTROL PANEL (115VU)
RUDDER TRIM
L 12
RESET
COMPUTATION PART (MASTER)
- Pedals inputs
- Yaw laws:
- Turn coordination
- Dutch roll damping
- Rudder travel limit
- Turbulence damping (yaw)
TO OTHER COMPUTERS
DEFLECTION ORDERS
EXECUTION PART
FROM PEDAL POSITION RVDTs
RATE GYRO UNIT
YAW RATE BCK UP
FCSC 1,2 (S1, S2)
ROLL
FCPC 1,2,3 (P1, P2, P3)
FMGEC 1,2
ADIRU 1,2,3
TURB DAMP
OFF
FLT CTL PANEL (241VU)
LATERAL ACCELEROMETER
TURB DAMP
MONITORING
CONTROL SIGNAL
FEEDBACK SIGNAL
P BLUE S.C.
P YELLOW S.C.
P SIGNAL
LOAD SYNCHRO.
ENERGIZED (28VDC)
SV
XDCERs
P2 BCM
SV
XDCERs
P1 S1
SV
XDCERs
P3 BCM
XDCER
P3 BCM
XDCER
P1 P2 S1
PDFU
RVDT
RVDT
RVDTs
XDCER
XDCER
M1
M2
S1
S2
Pedal Feel and Trim Unit (PFTU)
S.C.: Servo Control
Energized: Active Mode

GENERAL

YAW D/O (3)

MANUAL MODE

In manual mode, the rudder achieves the yaw control from the rudder pedals, the Rudder Trim (RUD TRIM) control panel, or the side sticks. The master computer, Flight Control Primary Computer 1 (FCPC1) in normal configuration, elaborates the yaw deflection order taking into account:
- yaw orders from the pedals,
- roll orders from the side sticks combined to ADIRU inputs (lateral acceleration) for turn coordination,
- ADIRU inputs (lateral acceleration) for dutch roll damping.

IN CASE OF ADIRUS FAILURE:
The rate gyro unit signals the master computer for dutch roll damping in alternate.
The yaw deflection orders are sent to the other FCPCs and to the Flight Control Secondary Computer (FCSC) 1 for servocontrols actuation. Each rudder servocontrol is connected to one FCPC.
In case of failure of the three primary computers, the middle servocontrol is automatically signaled by the FCSC1.
The three electro-hydraulic servocontrols operate simultaneously. They are controlled via a closed loop. The feedback signals are sent from feedback transducers in the rudder servocontrol. Additionally, transducers send the actual rudder position for monitoring functions.
SERVO CONTROL LOAD SYNCHRONIZATION
A differential pressure transducer located on each servocontrol sends P signals to the FCPCs.
This allows load synchronization between the three servocontrols by adjusting the servovalve current.
RUDDER TRAVEL LIMITATION
Depending on the aircraft speed, the rudder and pedal travels are limited in order to avoid excessive loads on the aircraft structure. This limitation function is integrated in the control laws computed by FCPCs and FCSCs.
The rudder position is displayed on the Flight Control (F/CTL) Electronic Centralized Aircraft Monitoring (ECAM) page via the Flight Control Data Concentrators (FCDCs). Only, the lower RVDT is used for indicating on the ECAM.

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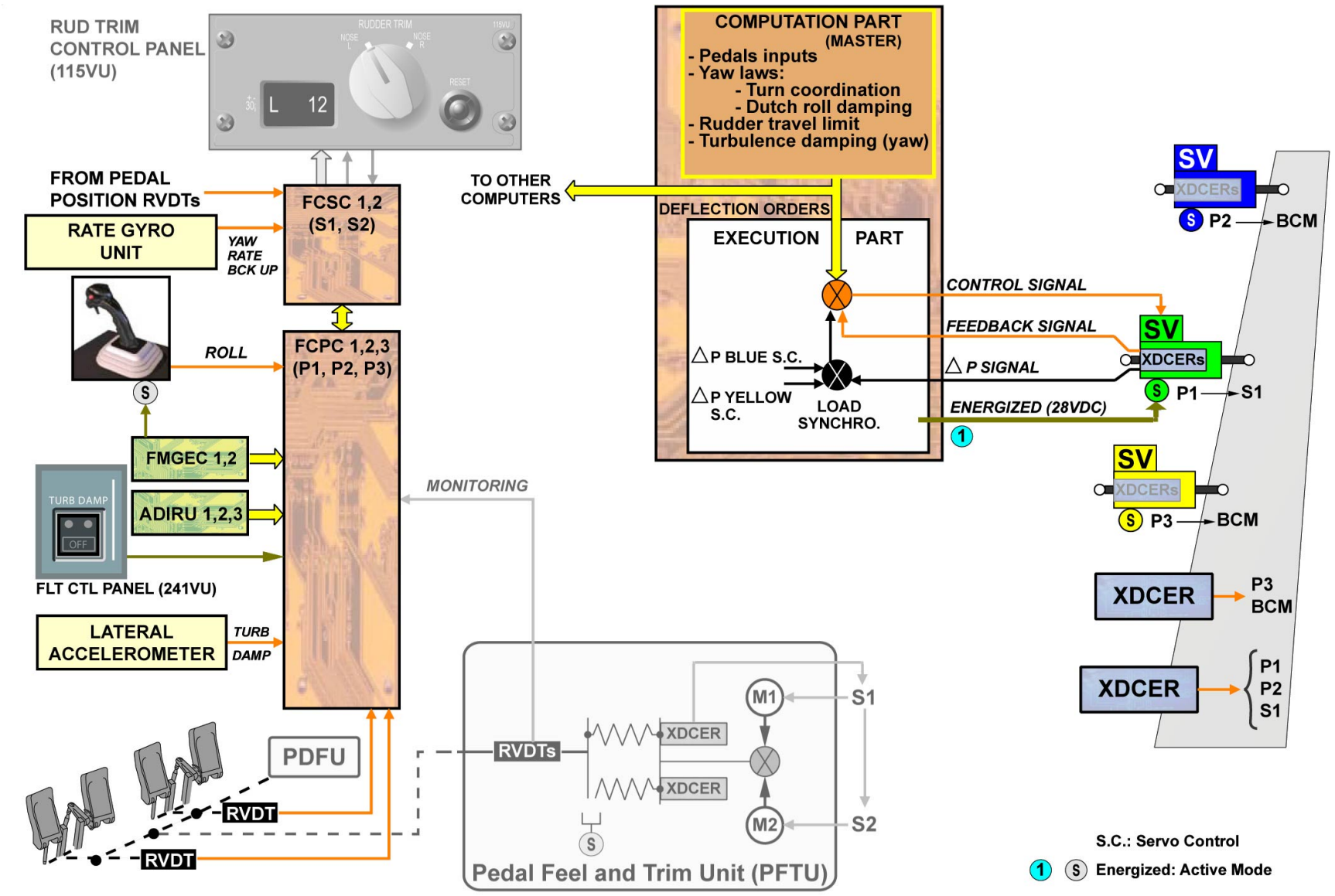

MANUAL MODE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

TRIM MODE

Artificial feel and trim forces are generated through the Pedal Feel and Trim Unit (PFTU). The unit includes two springs to give the artificial feel and the increased loading in Autopilot (AP) mode. The unit also includes two trim motors each controlled by one FCSC.
The Pedal Damper and Friction Unit (PDFU) improves the pilot feeling, by generating resisting torques into the Co-Pilot pedals.
In manual trimming, when the crew operates the RUD TRIM control switch, orders are sent to the FCSCs. FCSC 1 (priority) signals its dedicated trim motor, which produces a mechanical feedback to the rudder pedals. The pedal RVDTs will send signals to the FCPCs and FCSC1 to operate the rudder servocontrols for rudder trim. Trim RVDTs, located in the PFTU, send the trim position to the FCSCs for the servoing of the trim motors and for display on the RUD TRIM control panel. Lever RVDTs, located in the PFTU, send the pedal positions to FCPC2 and FCPC3 for monitoring functions.

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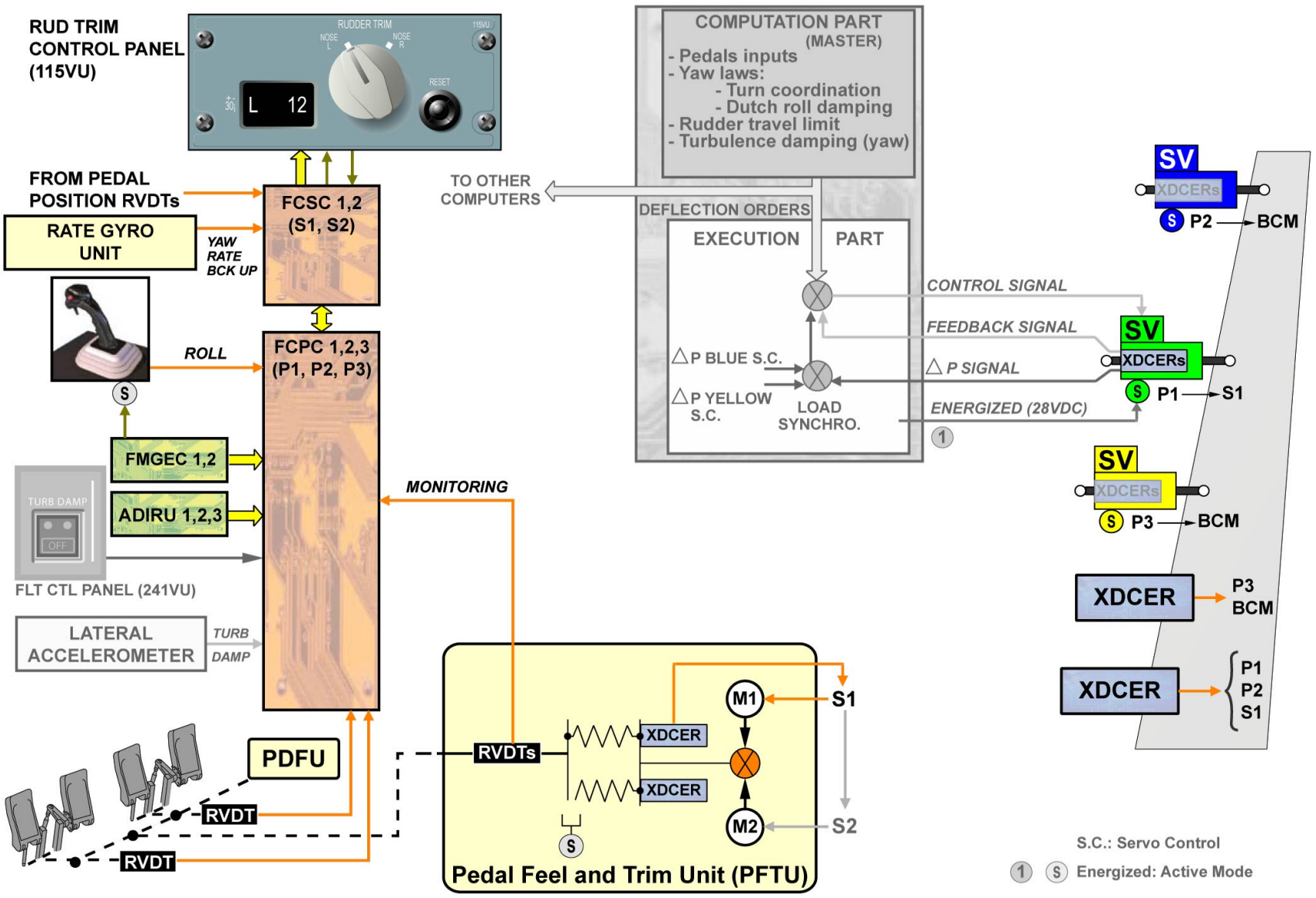

TRIM MODE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

AUTOPILOT MODE

In Autopilot (AP) mode the Flight Management Guidance and Envelope Computers (FMGECs) send guidance orders to the FCPCs. The master FCPC sends an AP trim order to the FCSC to command the PFTU to move the rudder pedals, and thus, the rudder moves as in manual mode. When the autopilot is engaged, a solenoid operated load threshold device, energized by FMGECs locks the side sticks. In addition, the FMGECs energize a solenoid on the rudder pedal artificial mechanism in order to lock the rudder pedals. In this case spurious commands at the rudder pedals are prevented, but AP overridden by the flight crew is still available.

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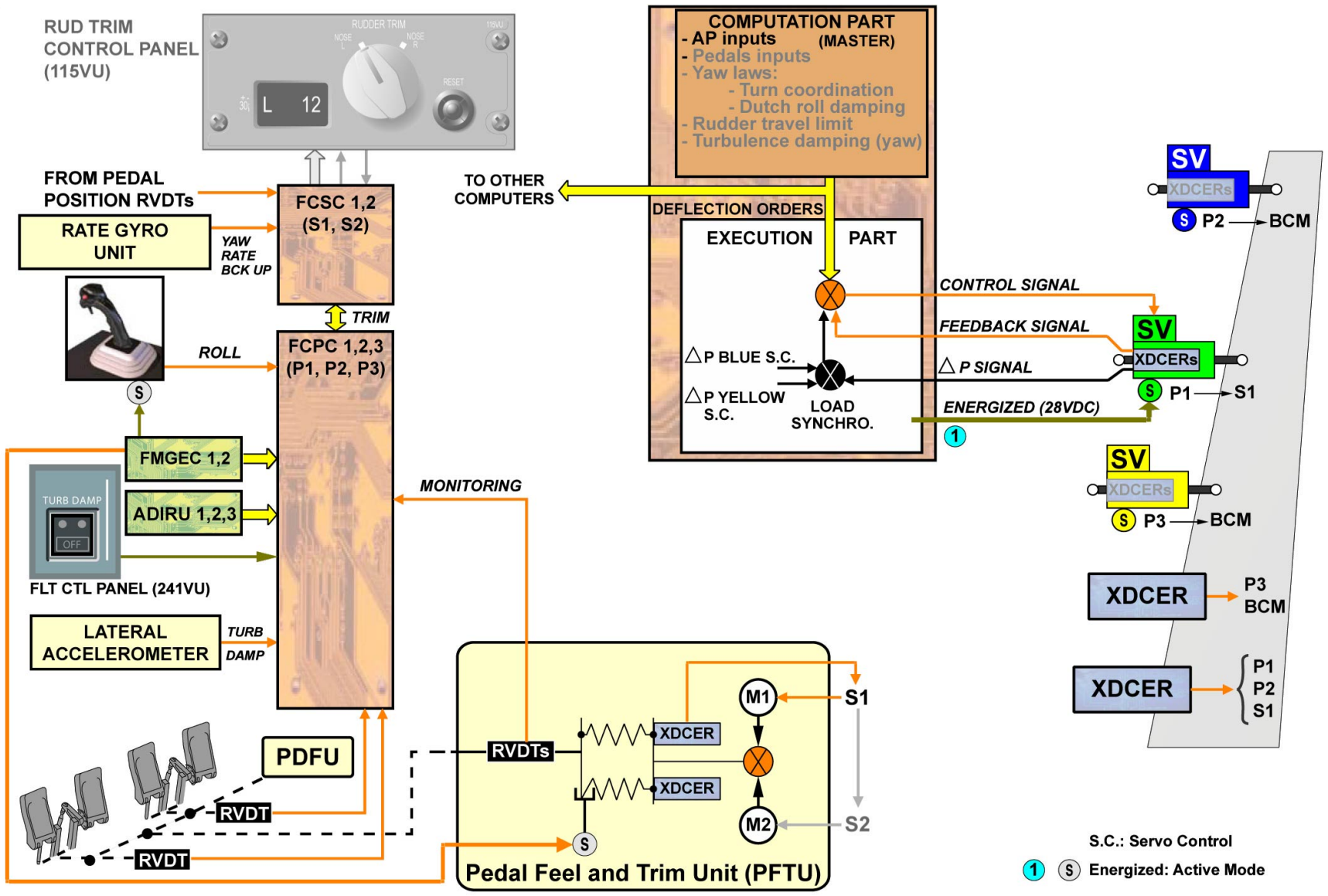

AUTOPILOT MODE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

ELECTRICAL BACKUP

If the normal electrical servoing is not operational, an electrical backup automatically takes over. The electrical backup has:
- two Backup Power Supplies (BPSs),
- and one Backup Control Module (BCM).

The two BPSs supply electrical power to the BCM. The BCM can operate the yellow or blue rudder servocontrols.

BACKUP POWER SUPPLY

Each BPS mainly has:
- an electrical power generator,
- a hydraulic motor which drives the rotor of the electrical generator,
- a solenoid valve with two separate windings.

In active mode, both inhibition signals from FCPC1 AND FCSC1 are lost, thus both windings of the solenoid valve are de-energized. The hydraulic flow supplies the hydraulic motor. The electrical generator is driven and delivers electrical power to the BCM. The BPS sends a 3-phase variable frequency AC voltage signal.

BACKUP CONTROL MODULE

The BCM operates automatically in the absence of inhibition signal from FCPC2 and FCPC3 and if at least one BPS is active. The BCM selects and controls one rudder servocontrol at a time (yellow servocontrol in priority). The middle servocontrol and one of the other two servocontrols switch to the damping mode.

It has the following functions:
- acquisition of signals from the pedal position RVDT in the PFTU,
- measuring of the yaw rate through its own rate gyro,
- computation of yaw orders calculated on the basis of pedal position and yaw rate via its own control law,
- servoing of the yellow (or blue) rudder servocontrol with acquisition of the feedback signal from the rudder upper RVDT.

NOTE: Note: Loss of P1, P2, P3, S1 can be caused by computer failure, electrical failure, P/BSW selected OFF or hydraulic system pressure information missing.

The BCM interfaces with the FCDC1 for Built-in Test Equipment (BITE) status.

A test of the electrical backup system is available through the Multipurpose Control & Display Unit (MCDU).

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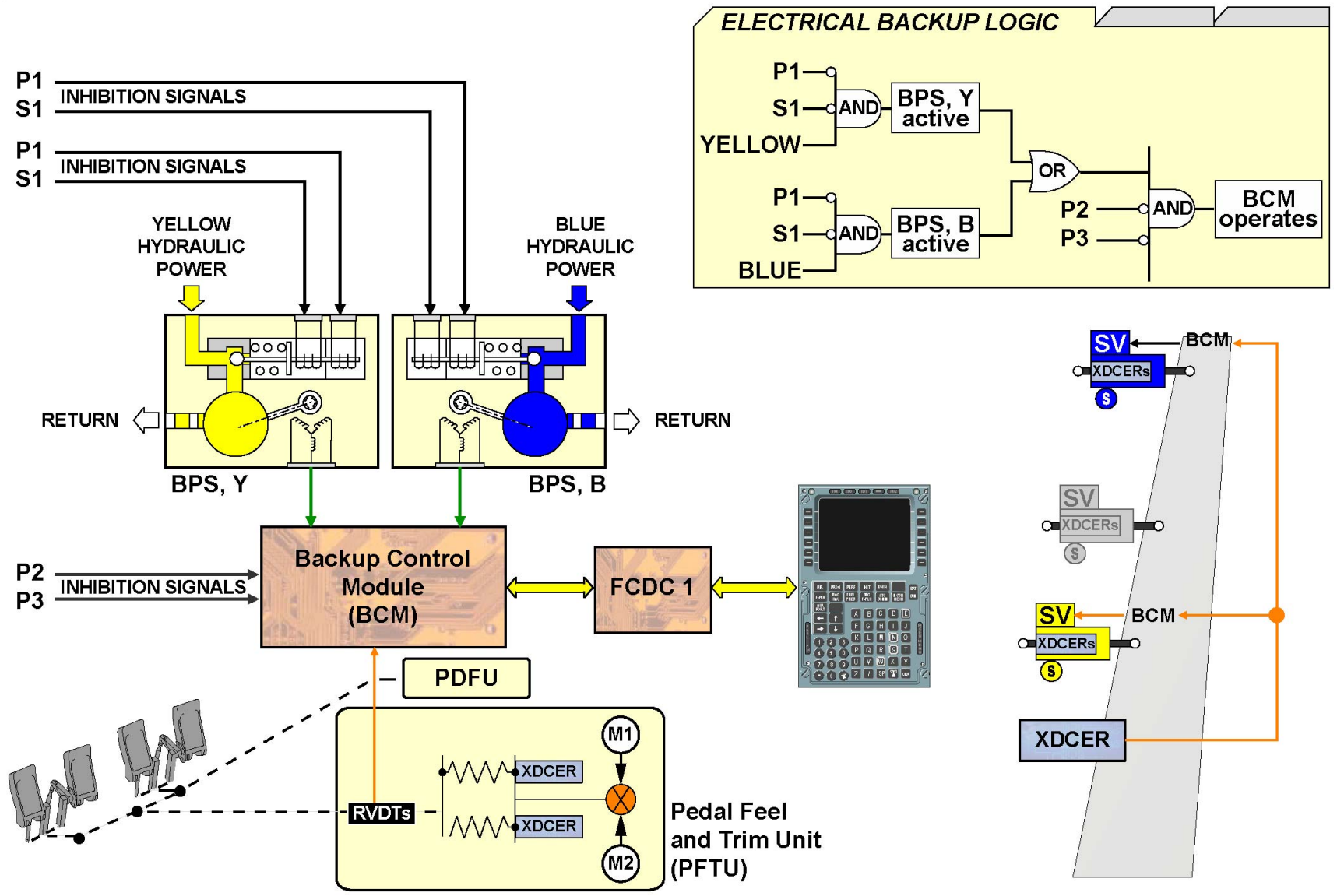

ELECTRICAL BACKUP - BACKUP POWER SUPPLY & BACKUP CONTROL MODULE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

SERVO CONTROL PRINCIPLES

ACTIVE MODE

In the active mode, the rudder servo-control actuator is pressurized and the solenoid valve energized by the computer.

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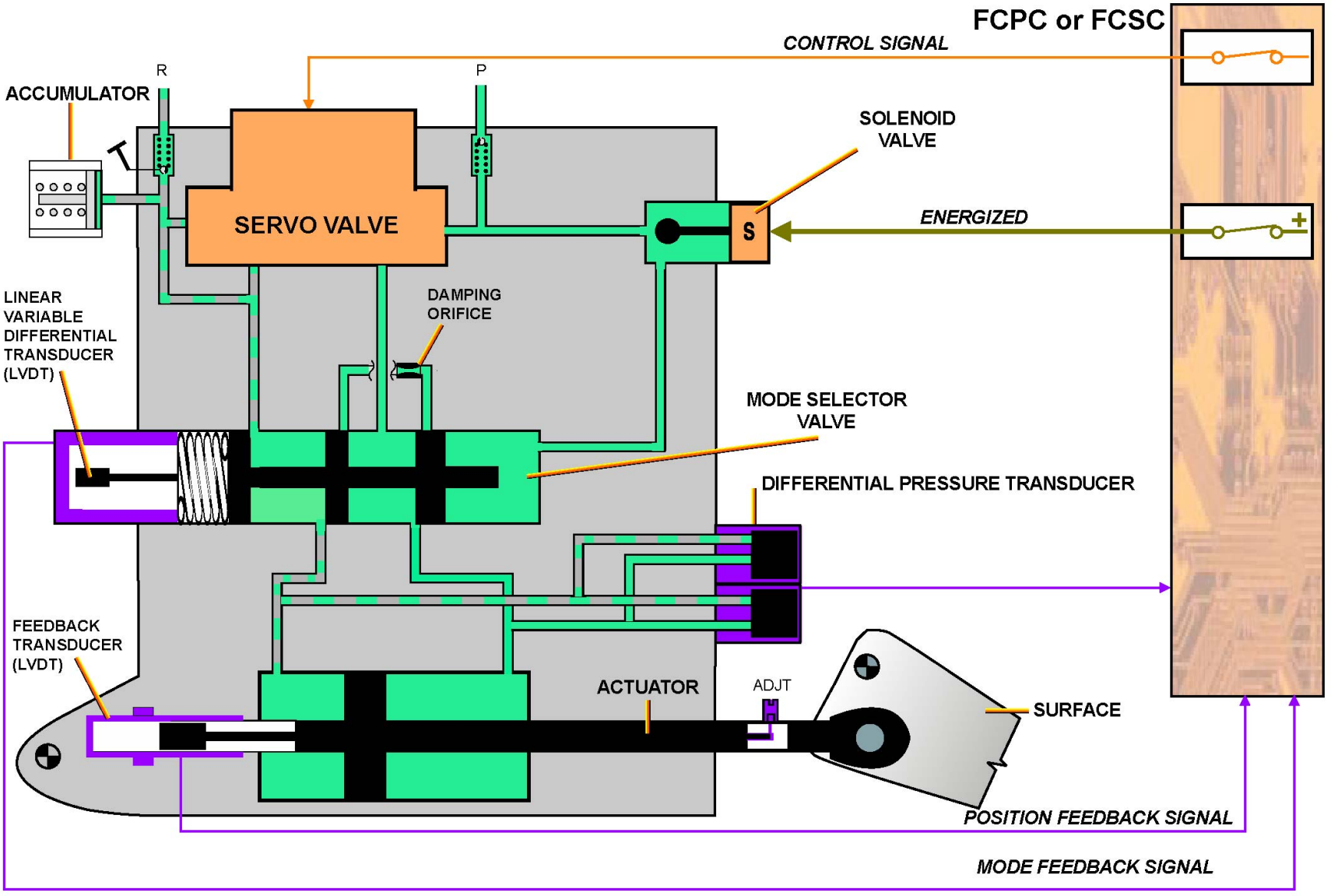

SERVO CONTROL PRINCIPLES - ACTIVE MODE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

SERVO CONTROL PRINCIPLES (continued)

DAMPING MODE

If the solenoid valve is de-energized or the servo-control actuator is not pressurized, the servo control actuator is in damping mode. In damping mode, the actuator follows the control surface movements.

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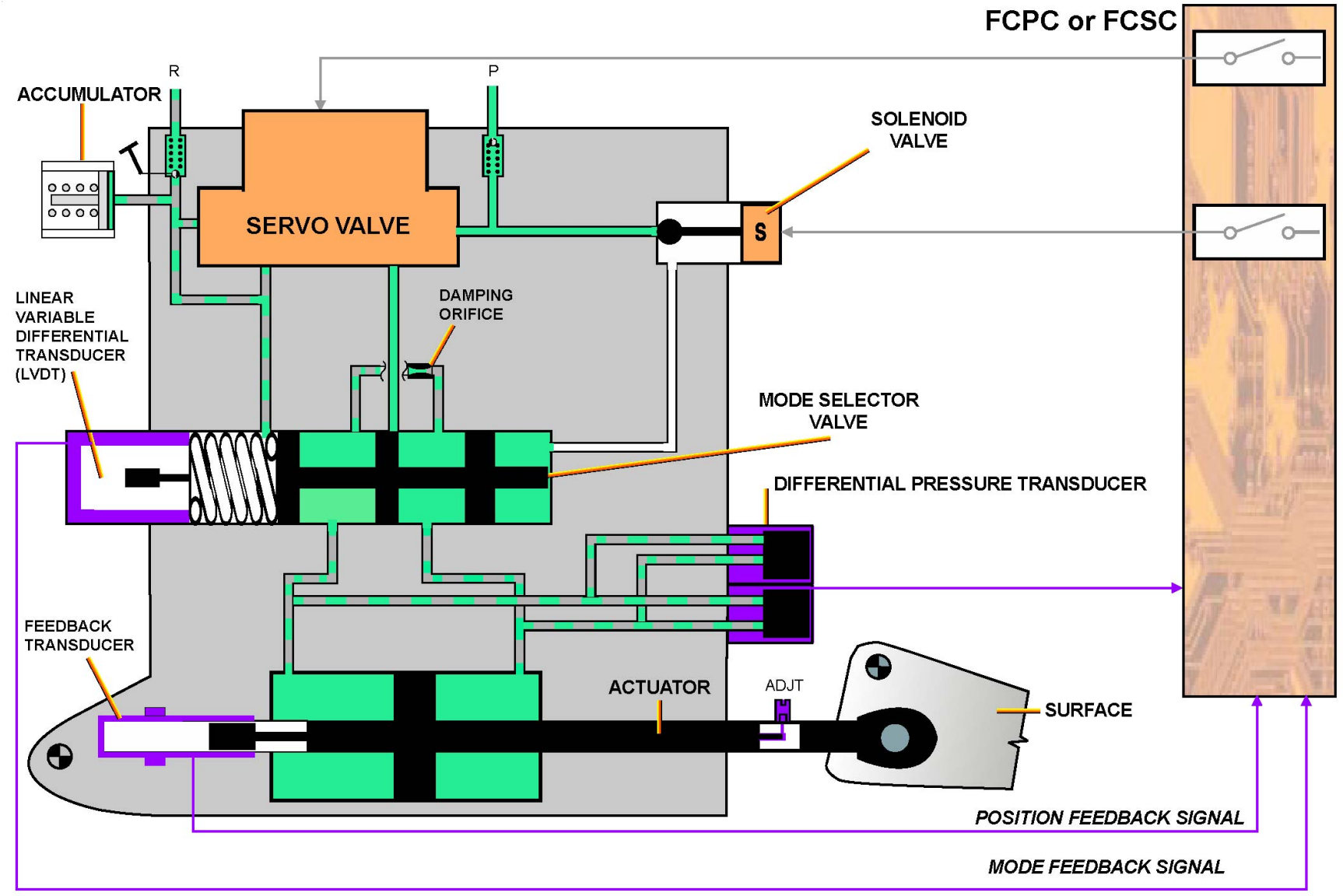

SERVO CONTROL PRINCIPLES - DAMPING MODE

G9409341 - GAUT0T0 - FM27D4000000003

YAW D/O (3)

SERVO CONTROL PRINCIPLES (continued)

MAINTENANCE/ADJUSTMENT

No accumulator and valves test is given. Only a discharge point is installed.
The adjustment is possible by acting on the position feedback device.

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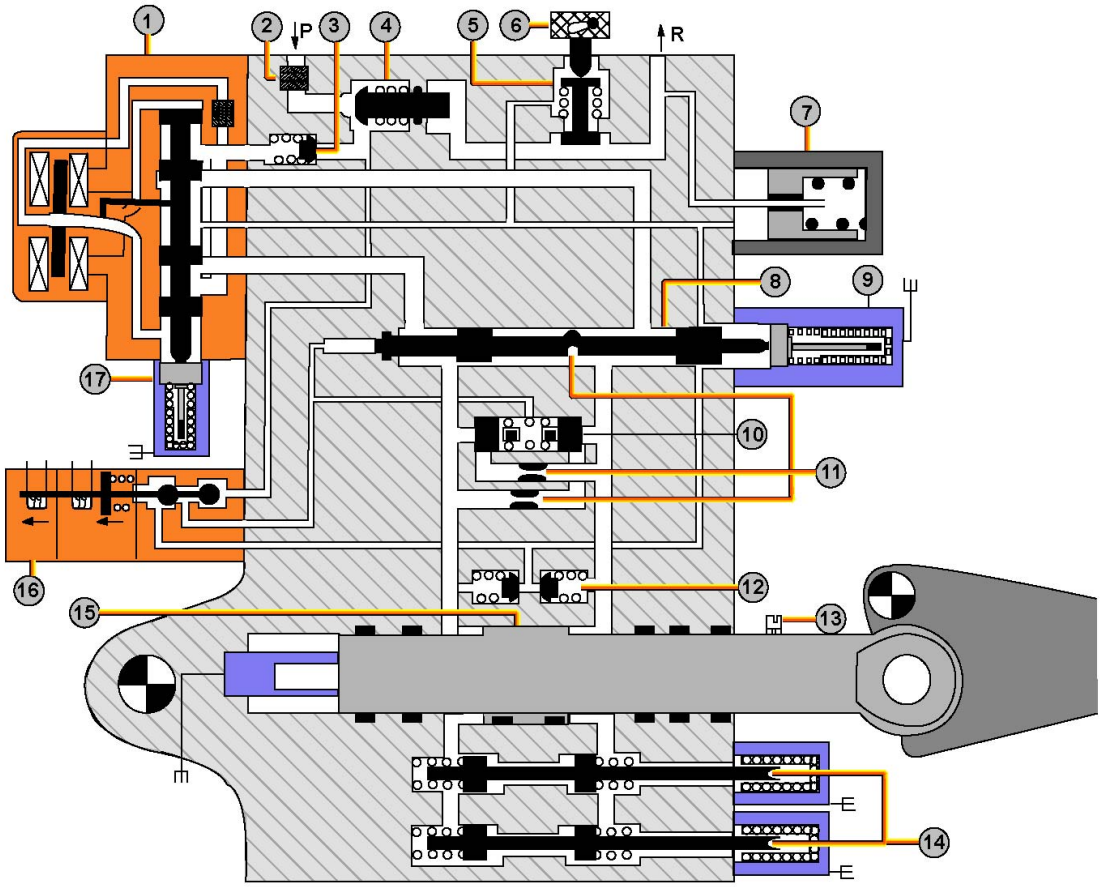


1 SERVOVALVE
2 FILTER
3 CHECK VALVE
4 INLET BLOCKING VALVE
5 RETURN BLOCKING VALVE
6 DISCHARGE DEVICE
7 ACCUMULATOR
8 MODE SELECTOR VALVE
9 MODE SELECTOR VALVE PUSHBUTTON TRANSDUCER UNIT
10 OVERPRESSURE VALVE
11 DAMPING RESTRICTORS
12 ANTICAVITATION VALVES
13 FEEDBACK TRANSDUCER ADJUSTMENT DEVICE
14 DIFFERENTIAL PRESSURE TRANSDUCER
15 FEEDBACK TRANSDUCERS
16 SOLENOID VALVE
17 SERVOVALVE POSITION TRANSDUCER

SERVO CONTROL PRINCIPLES - MAINTENANCE/ADJUSTMENT

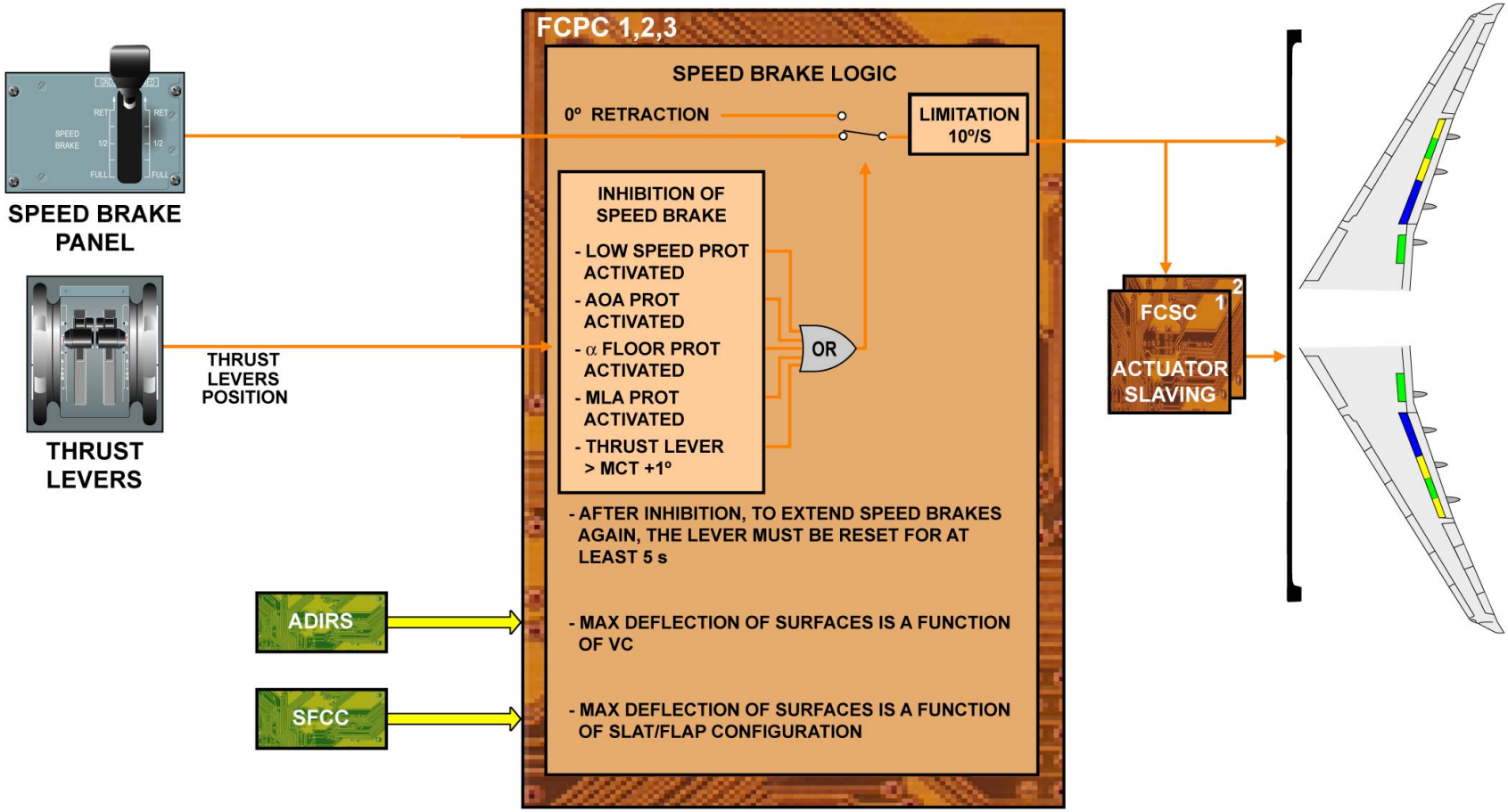
G9409341 - GAUT0T0 - FM27D4000000003

PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

SPEED BRAKE FUNCTION AND LOGIC

The speed brake function is commanded in the flight phase following a pilot's action on the speed brake lever. The surfaces ensuring this function are spoilers 1 through 6, being deflected depending on the lever position.
The roll order has priority over the speed brake function. When the sum of roll and speed brake commands, relative to one surface, is greater than the maximum possible deflection, the symmetrical surface is retracted until the difference between the two surfaces is equal to the roll order.
If the Angle Of Attack (AOA) protection, or the Alpha Floor protection, or the Low Speed protection, or if the Maneuver Load Alleviation (MLA) function are activated or if one the Thrust lever is above MCT with speed brakes extended, the speed brakes are automatically retracted. The retraction is announced by an ECAM message. After inhibition, to extend speed brakes again, the lever must be reset for at least 5 seconds. The pitching moment associated to speed brake extension or retraction is compensated by the pitch control laws and the switching made to alternate or direct laws does not affect the speed brake function.
For spoilers 1, 2, 3 and 5, when one surface is not available on one wing, the symmetrical one is inhibited. For spoilers 4 and 6, the faulty servo-control is inhibited while the symmetrical one remains active for the roll control only.

G9409341 - GAUT0T0 - FM27D5F27FM0403


FCPC 1,2,3
SPEED BRAKE LOGIC
0° RETRACTION
LIMITATION 10°/S
INHIBITION OF SPEED BRAKE
- LOW SPEED PROT ACTIVATED
- AOA PROT ACTIVATED
- α FLOOR PROT ACTIVATED
- MLA PROT ACTIVATED
- THRUST LEVER > MCT +1°
OR
- AFTER INHIBITION, TO EXTEND SPEED BRAKES AGAIN, THE LEVER MUST BE RESET FOR AT LEAST 5 s
- MAX DEFLECTION OF SURFACES IS A FUNCTION OF VC
- MAX DEFLECTION OF SURFACES IS A FUNCTION OF SLAT/FLAP CONFIGURATION
SPEED BRAKE PANEL
THRUST LEVERS
THRUST LEVERS POSITION
ADIRS
SFCC
FCSC 1 2
ACTUATOR SLAVING

SPEED BRAKE FUNCTION AND LOGIC

G9409341 - GAUT0T0 - FM27D5F27FM0403

PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

LIFT DUMPING (GROUND SPOILERS) FUNCTION AND LOGIC

The lift dumping function is automatic and it is activated upon landing to increase the breaking efficiency. Extension of all spoilers is achieved when the A/C is on ground with ground spoilers armed or reverse selected. Ground spoilers are ARMED when the speed brake control lever is pulled up. When the logic conditions which determine the lift dumper extension are fulfilled, a deflection order is sent to spoilers 1 to 6. If only one MLG shock absorber is compressed, the phased lift dumping function is activated at reverse selection.

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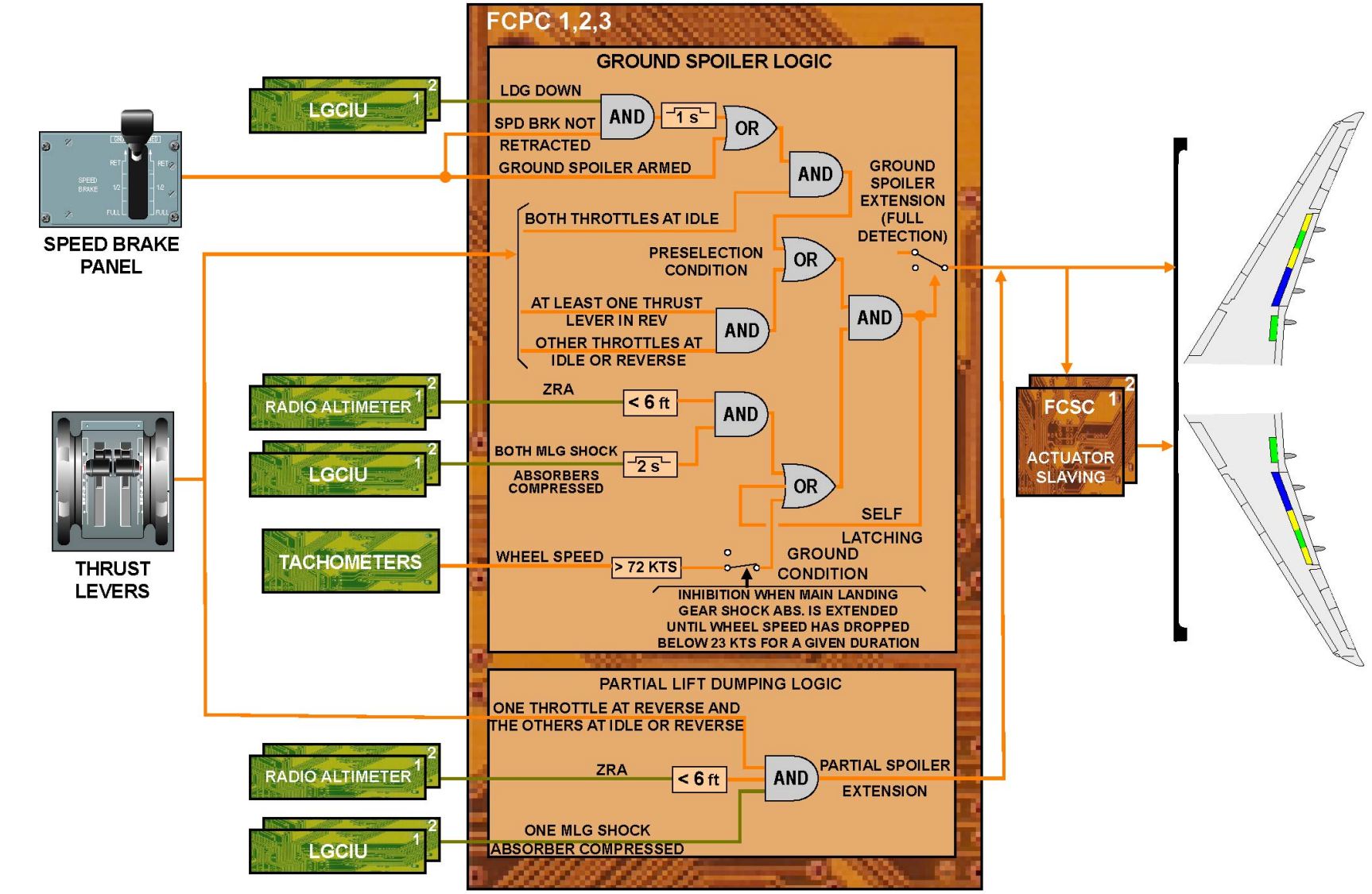

LIFT DUMPING (GROUND SPOILERS) FUNCTION AND LOGIC

G9409341 - GAUT0T0 - FM27D5F27FM0403

PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

SERVO CONTROL PRINCIPLES

ACTIVE MODE

In active mode, the spoiler servo control actuator is hydraulically supplied. According to the command signal to the servo valve, the spoiler surface will extend or retract.

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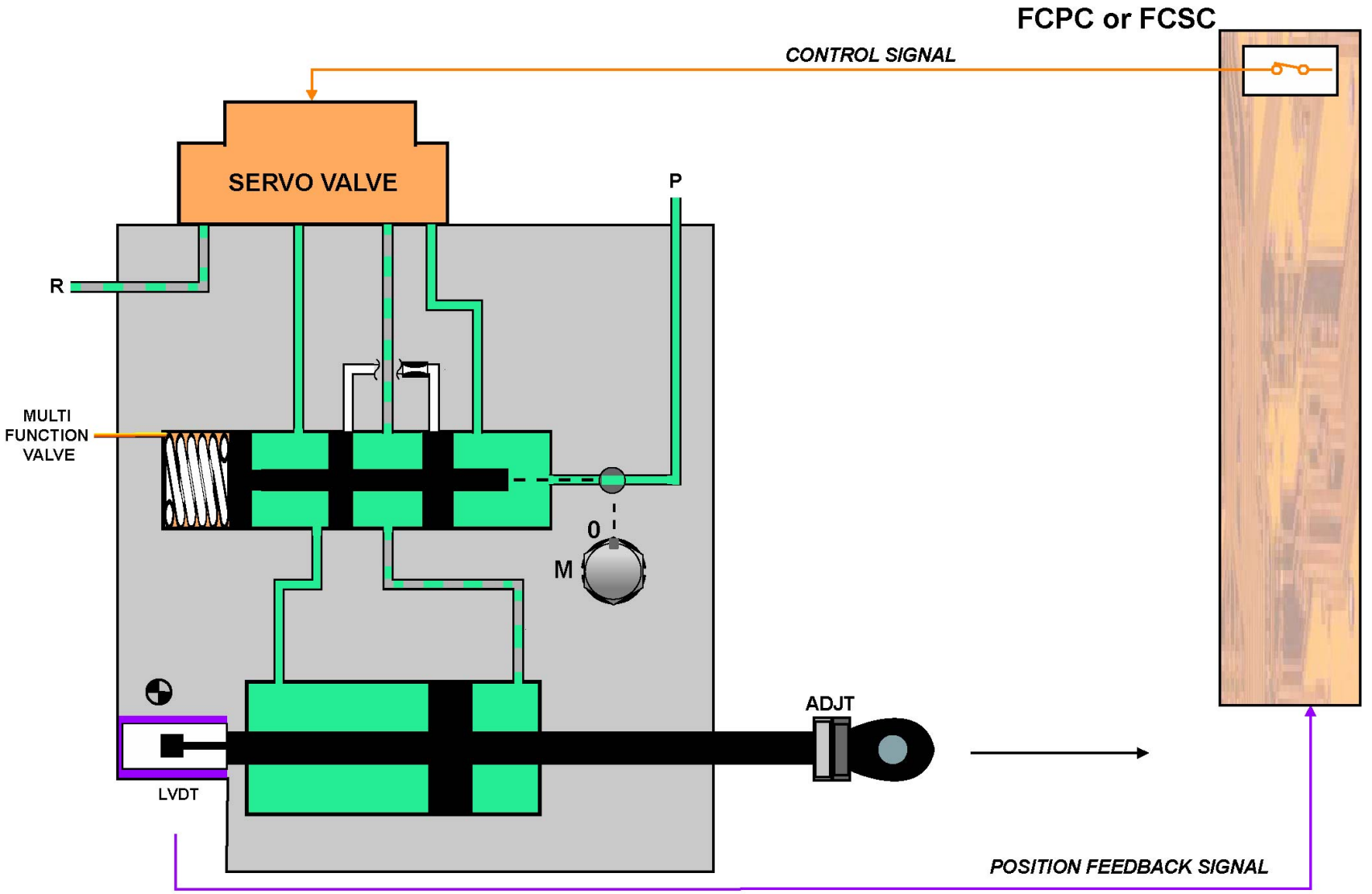

SERVO CONTROL PRINCIPLES - ACTIVE MODE

G9409341 - GAUT0T0 - FM27D5F27FM0403

PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

SERVO CONTROL PRINCIPLES (continued)

BIASED MODE

The servo control actuator is pressurized. Due to an electrical failure, the command signal is lost. The biased servo valve pressurizes the retraction chamber. The spoiler actuator stays pressurized and the spoiler remains retracted.

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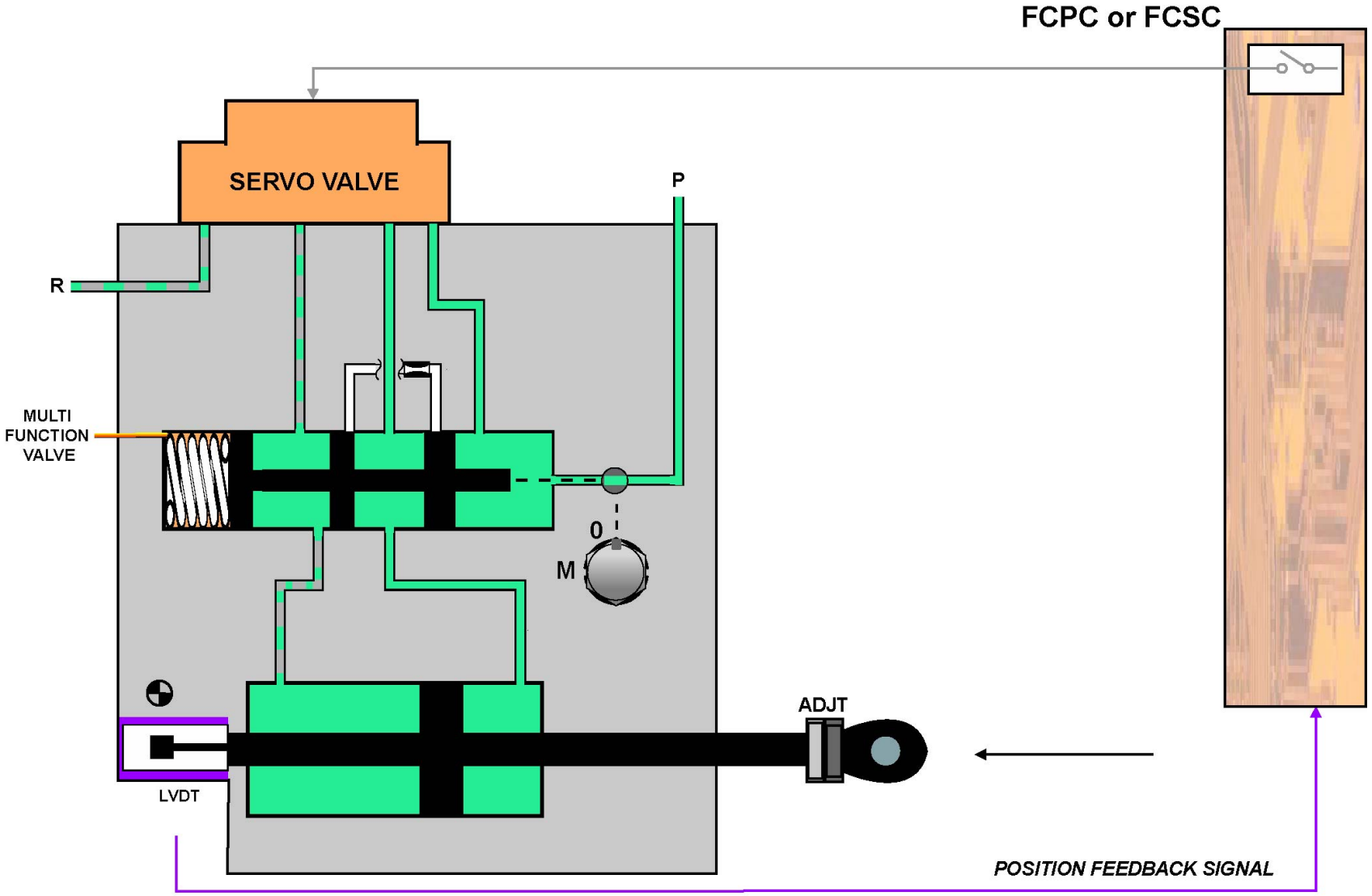


SERVO CONTROL PRINCIPLES - BIASED MODE

G9409341 - GAUT0T0 - FM27D5F27FM0403

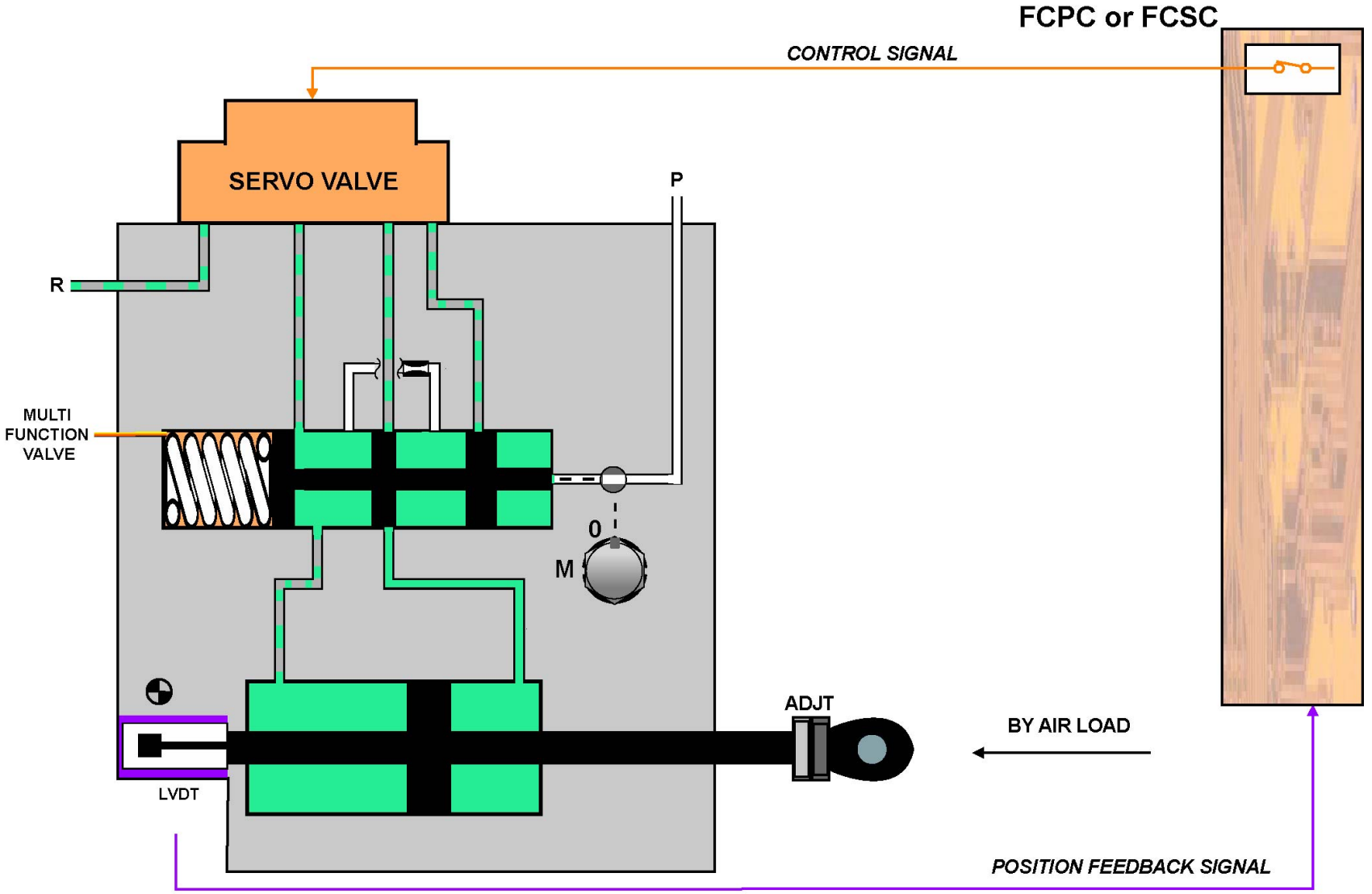
PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

SERVO CONTROL PRINCIPLES (continued)

LOCKED MODE

In locked mode, the hydraulic pressure is lost. The surface can only be moved towards the retracted position, pushed by aerodynamic forces.

G9409341 - GAUT0T0 - FM27D5F27FM0403



SERVO CONTROL PRINCIPLES - LOCKED MODE

G9409341 - GAUT0T0 - FM27D5F27FM0403

PRIMARY CONTROL SPEED BRAKE & LIFT DUMPING D/O (3)

SERVO CONTROL PRINCIPLES (continued)

MANUAL MODE

To be unlocked, the servo control actuator must be pressurized. The maintenance unlocking device can be engaged thanks to a key equipped with a red flame. This tool cannot be removed when the servo control is in maintenance mode. Once the maintenance unlocking device is engaged the spoiler surface can be raised manually for inspection purposes.
Servo cut-out

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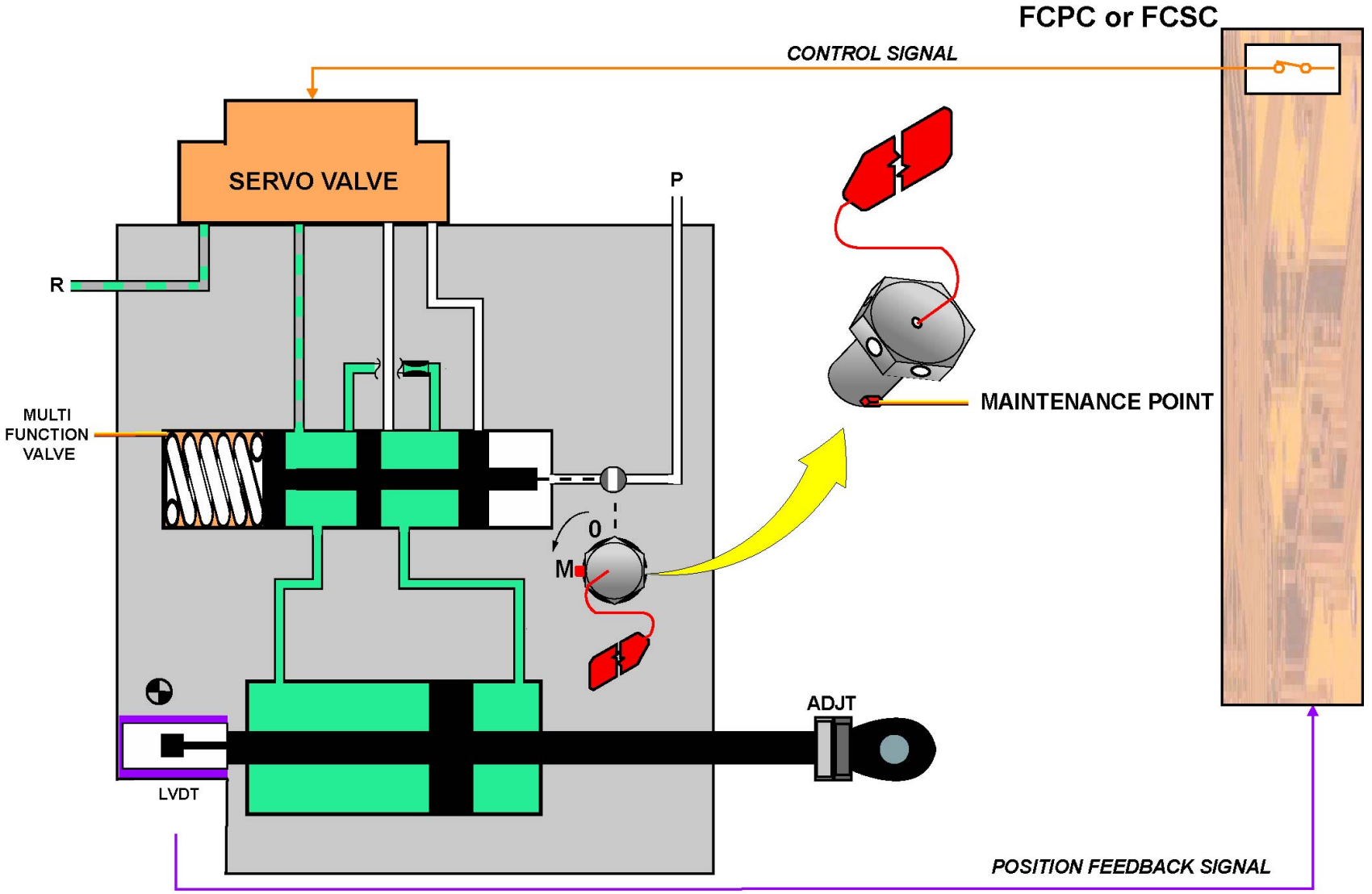

SERVO CONTROL PRINCIPLES - MANUAL MODE

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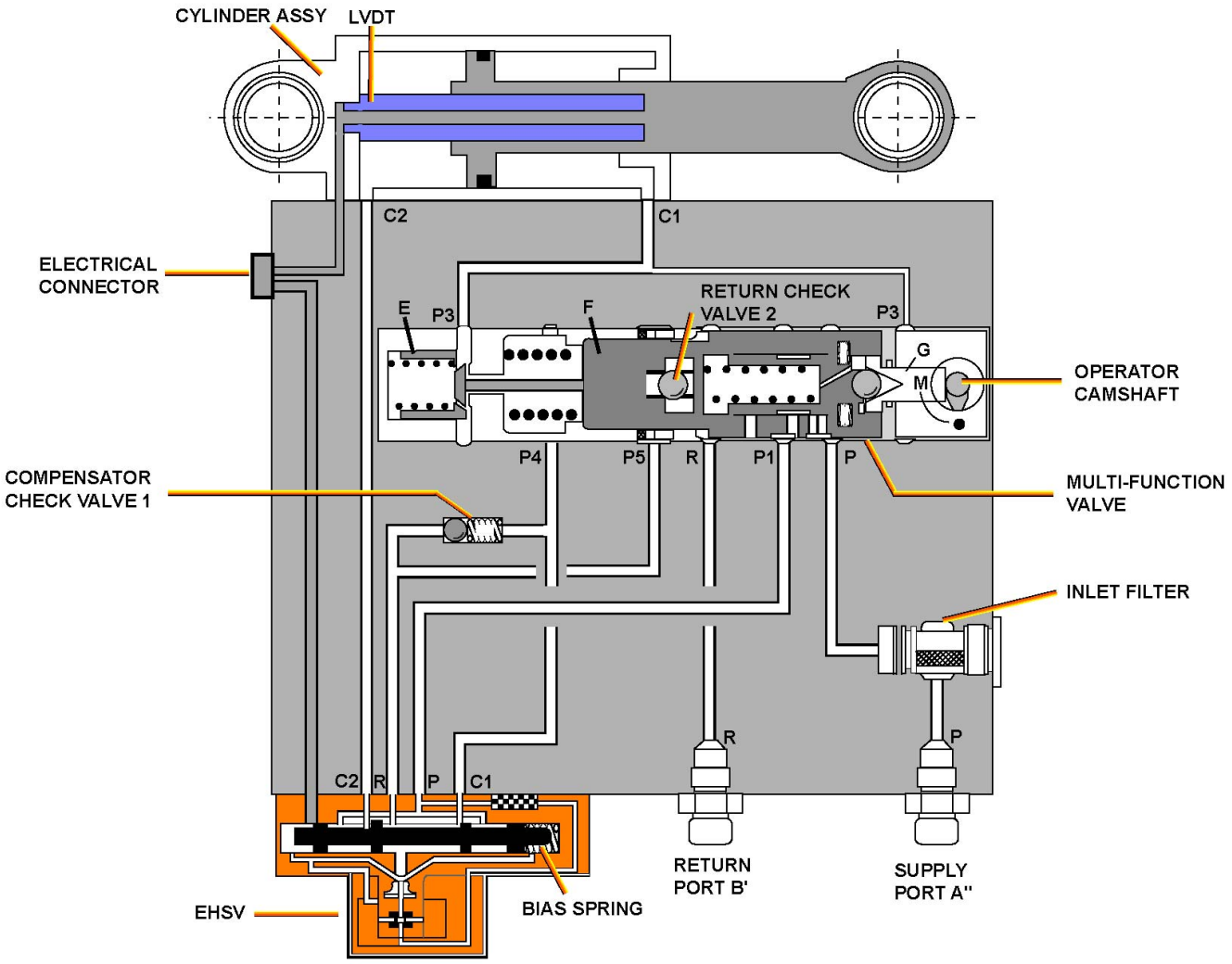

SERVO CONTROL PRINCIPLES - MANUAL MODE

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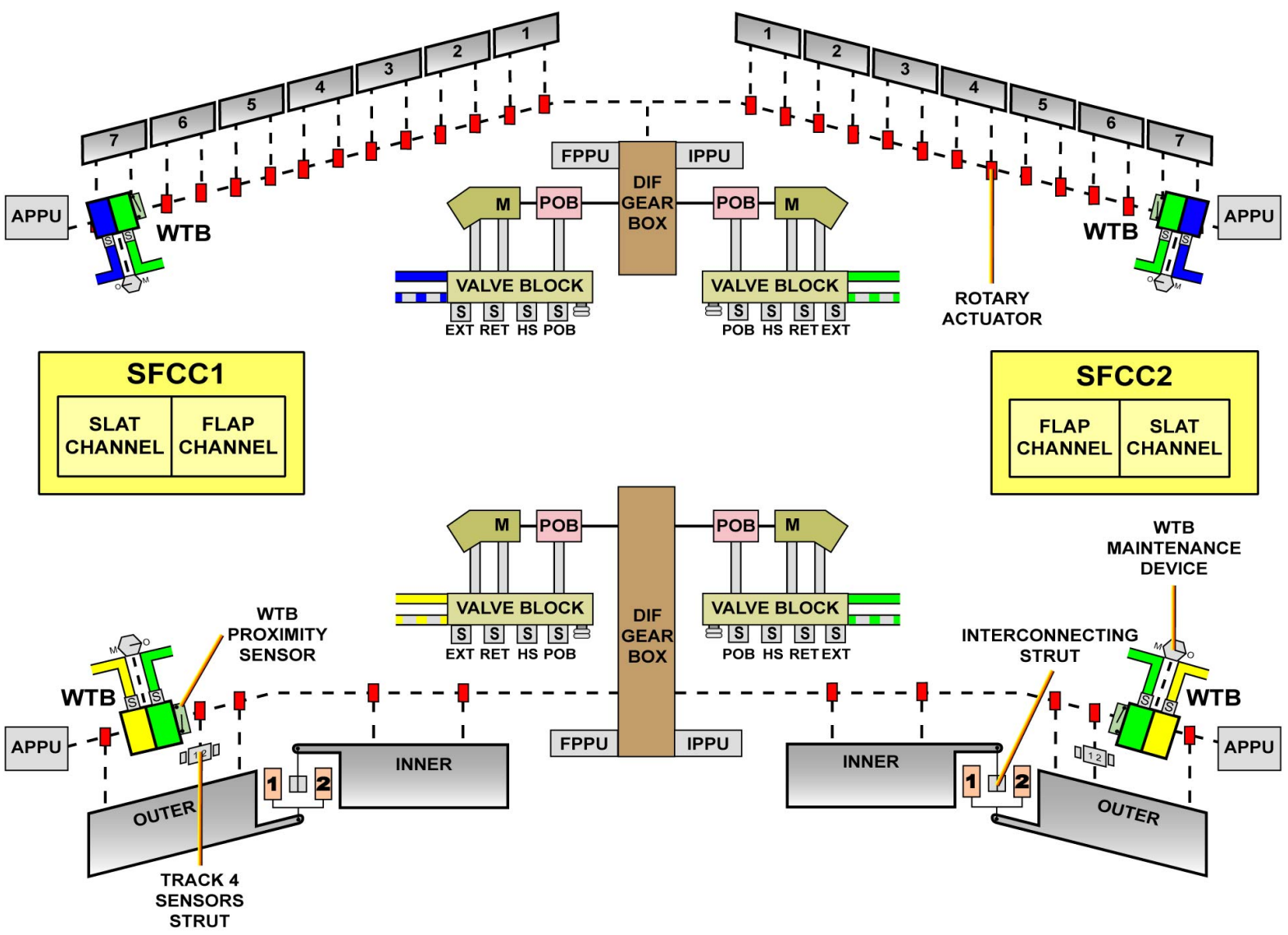
SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

GENERAL

The secondary control SLAT and FLAP transmission includes
- SLATS
- FLAPS
- APPUs
- FPPUs
- IPPUs
- SFCCs
- WTBs
- Valve blocks
- Motors
- POBs
- Differencial gearboxes
- Rotary actuators

G9409341 - GAUT0T0 - FM27D6000000002



GENERAL

G9409341 - GAUT0T0 - FM27D6000000002

SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

CONTROL LEVER/COMMAND SENSOR UNIT (CSU)

The lever assembly with the quadrant and the spring-loaded plunger has five-position gate (0, 1, 2, 3, FULL). A plate above the first and third notches gives two stops, which determines the take-off and landing range selections

To move the lever, lift the collar against the spring pressure. The pin comes clear of the notch. To move the lever past the stop, lower the collar again. This prevents full travel of the lever in one movement.

The CSU is a sealed unit below the control lever, which changes the mechanical commands from the slat/flap control lever to electrical commands to the SFCCs.

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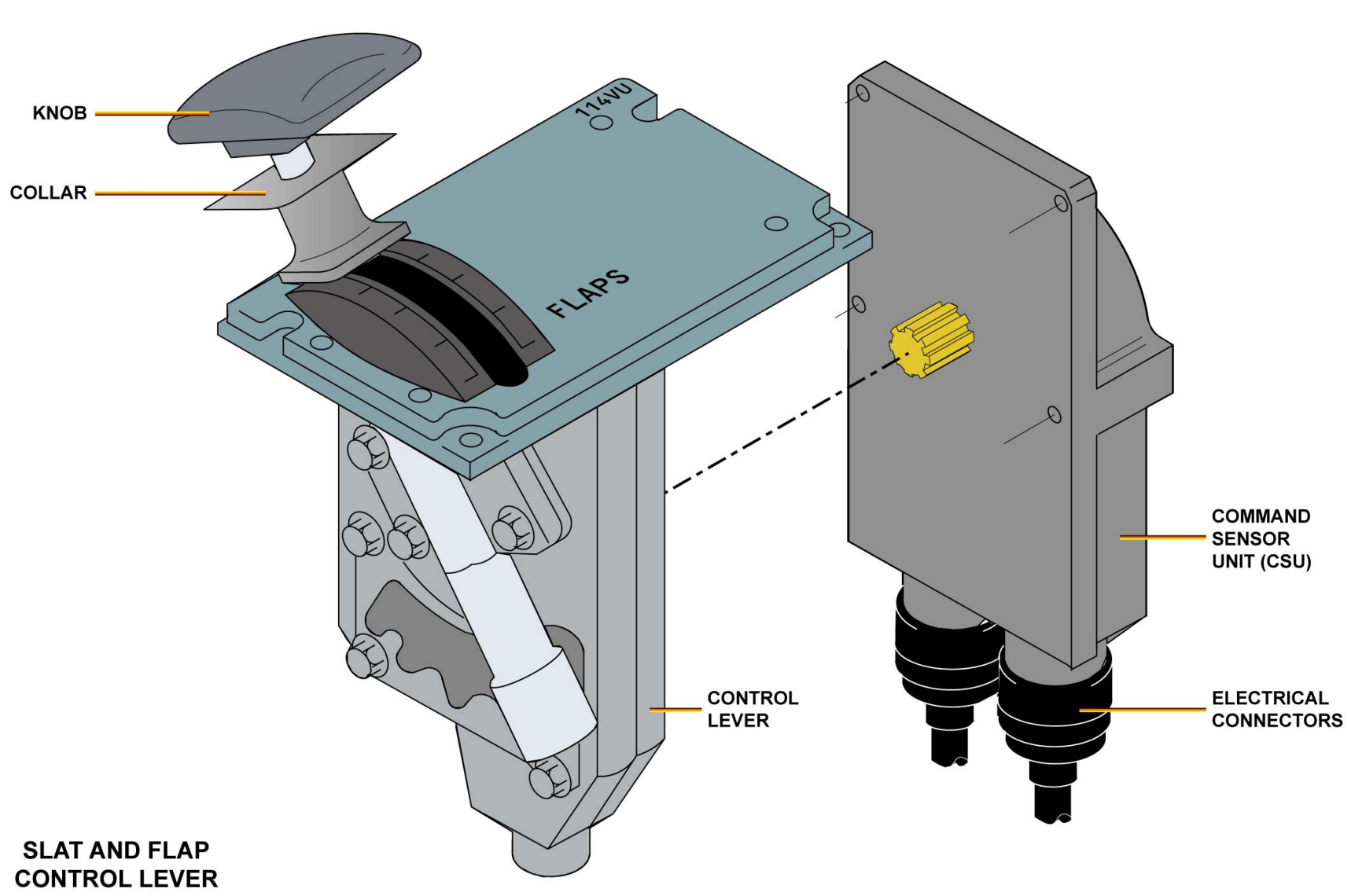

CONTROL LEVER/COMMAND SENSOR UNIT (CSU)

SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

SLAT AND FLAP CONTROL COMPUTER (SFCC)

Located in the avionic bay, each computer has two channels, one for the slats, one for the flaps. Each channel has two lanes (lane A and lane B). Each channel has its own 28 V DC power unit.
Each channel of both SFCCs permanently cross talk to validate their inputs.
SFCC1 is in charge of the Slat channel using the Green hydraulic system and the Flap channel using the Yellow hydraulic system. SFCC 2 is in charge of the Slat channel using the Blue hydraulic system and the Flap channel using the Green hydraulic system.

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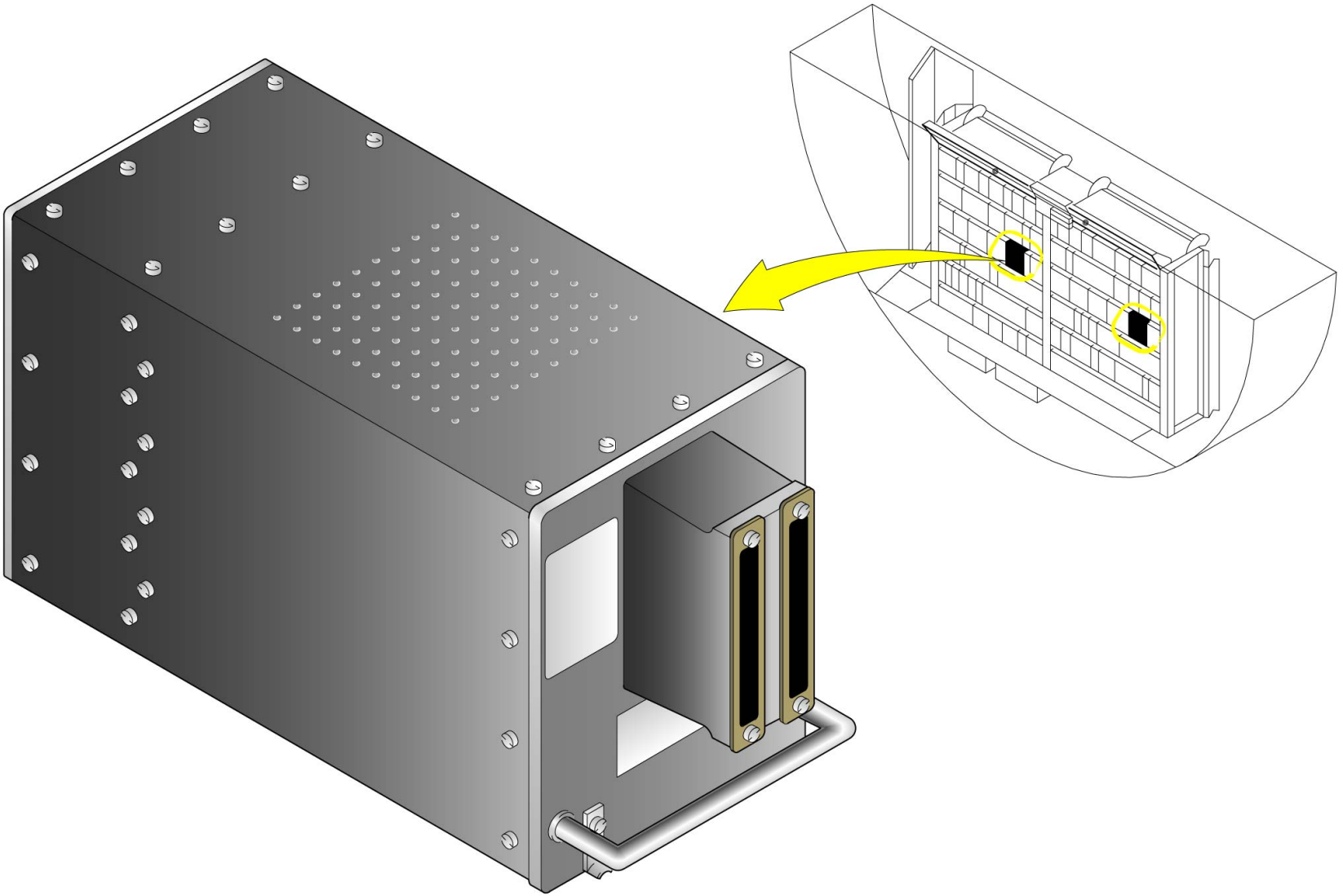

SLAT AND FLAP CONTROL COMPUTER (SFCC)

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

POWER CONTROL UNIT (PCU)

The PCUs drive the transmission system and transmit power through the torque shafts down to the Wing Tip Brakes/APPUs.
The PCU incorporates two differentially coupled hydraulic motors, supplied by two separate hydraulic sources via two individual electrically supplied valve blocks.
If one motor is inoperative, the remaining one provides full output torque but the transmission system operates at half of the normal operation speed.
PCUs have two valve blocks, which are electrically controlled.
Each valve block controls the flow of hydraulic fluid to its related hydraulic motor and POB. The two valve blocks are the same and interchangeable.
The valve blocks of the flap PCU have the same components as those of the slat PCU. The flap PCU valve blocks are interchangeable with those of the slat PCU.
The primary components of a valve block are:
- four solenoid valves,
- a pressure switch,
- a pressure maintain valve,
- a main control valve,
- an inlet filter,
- a pressure port,
- a return port,
- an electrical connector.

The four solenoid valves are referred to as:
- extend solenoid valve,
- retract solenoid valve,
- high-speed solenoid valve,
- POB solenoid valve.

The four solenoid valves of the PCUs are the same and interchangeable. They are not interchangeable with the solenoid valves of the wing tip brakes.

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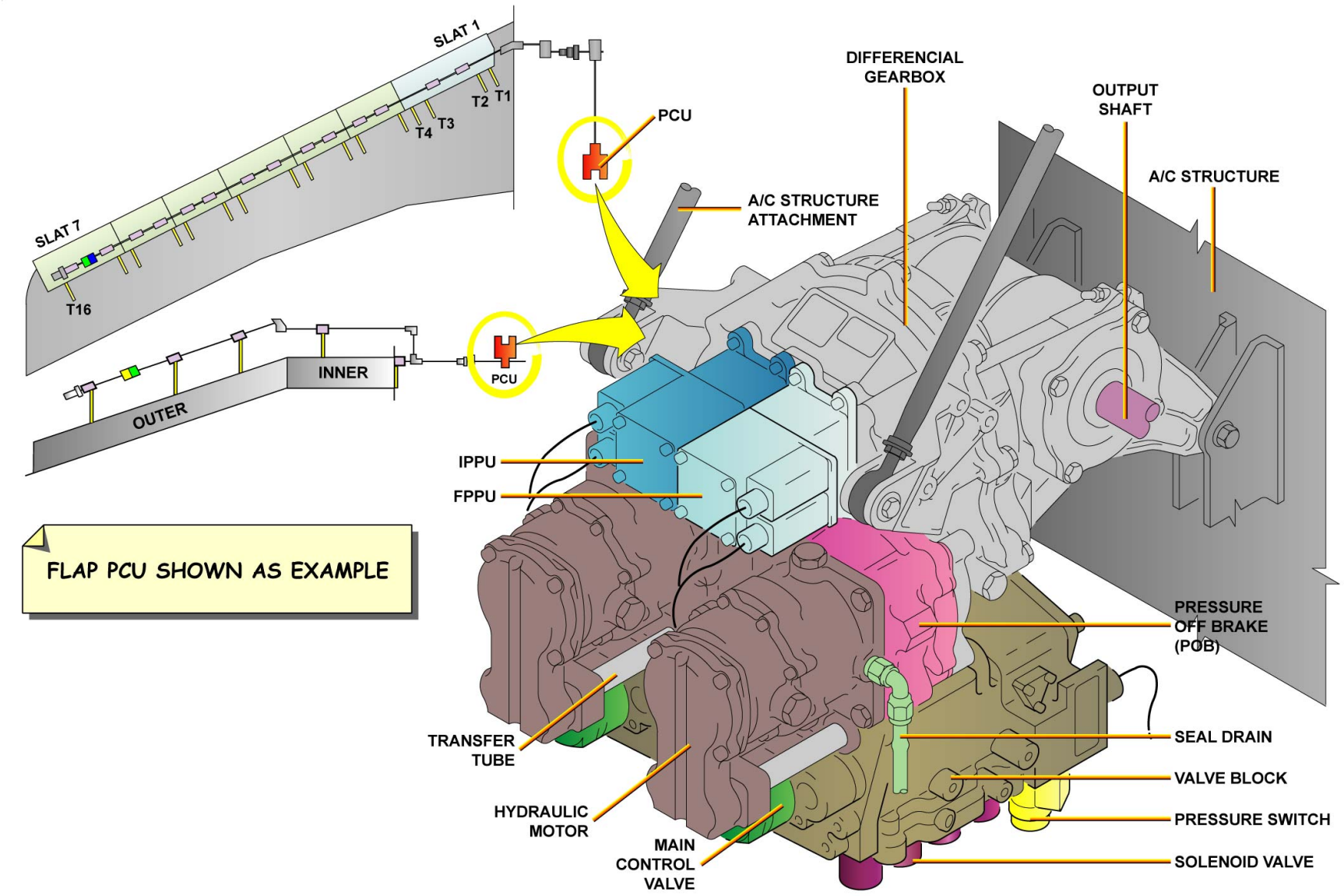

POWER CONTROL UNIT (PCU)

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

POSITION PICK OFF UNITS (IPPU/FPPU/APPU)

Position Pick-off Units (PPU) consist of duplicated synchro transmitters driven by a single input shaft through a reduction gearing. A Feedback Position Pick off Unit (FPPU) and an Instrumentation Position Pick off Unit (IPPU) are mounted on each PCU gearbox casing. Asymmetry Position Pick-off Units (APPU) are mounted on the aircraft structure via adaptator assemblies at the LH and RH ends of the transmissions.
FPPUs and APPUs send transmission position data to the SFCCs. These data are used for system monitoring. IPPU send position data to the Flight Warning Computers (FWC) for display on the ECAM.
PPUs are hermetically sealed and their internal gearing is lubricated for life. A transparent window, located in the cover plate allows zero adjustment through a system of matching marker lines, in the casing and on the rotating shaft. A spring-loaded locking plate holds the splined input shaft when PPU is removed. When installed on aircraft, PPU mounting pushes the locking plate clear of the spline shaft.
FPPUs, IPPUs and APPUs are identical and interchangeable.

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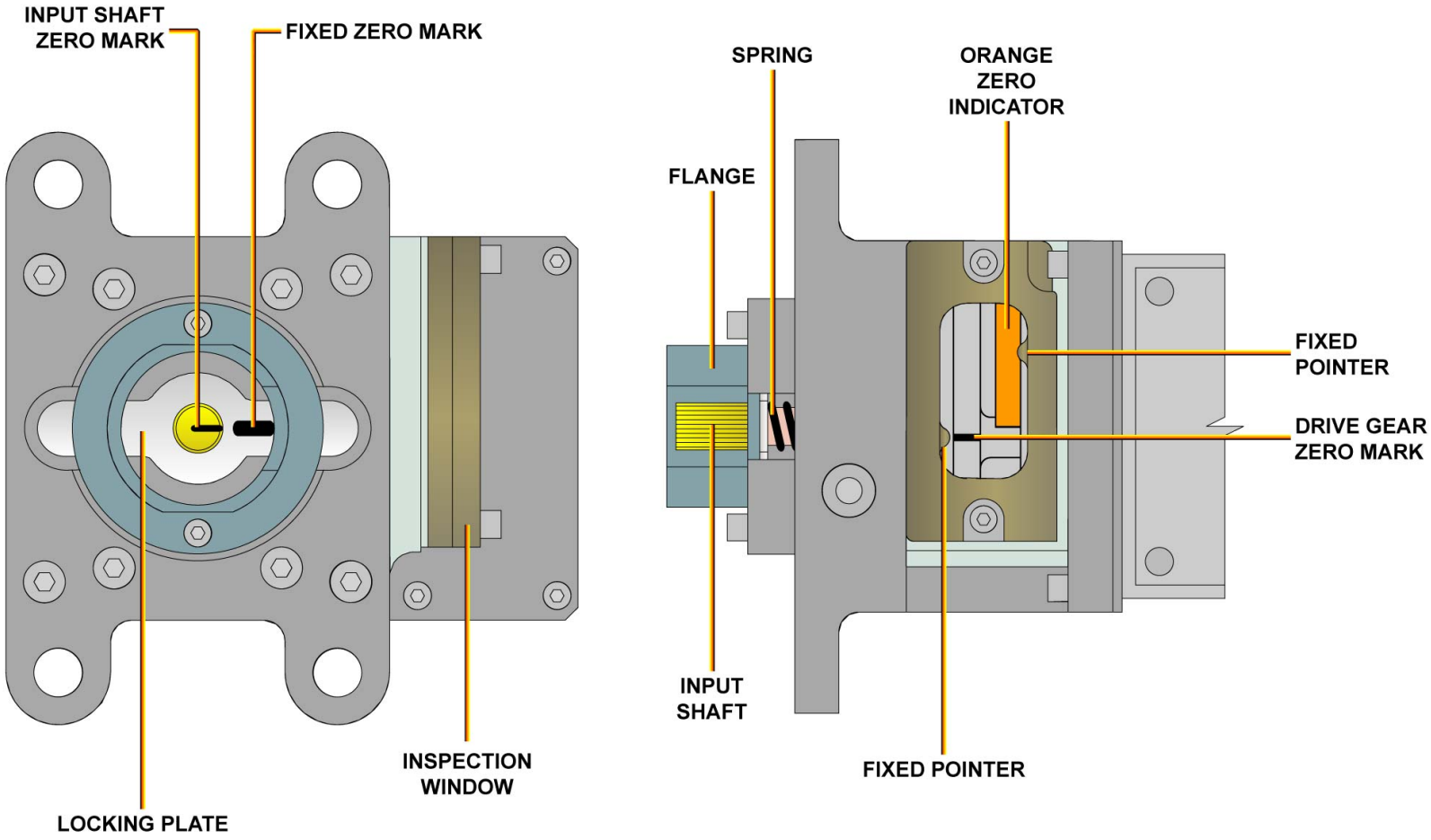

POSITION PICK OFF UNITS (IPPU/FPPU/APPU)

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

SYSTEM TORQUE LIMITERS

In order to prevent too much load from being transmitted to the structure, system torque limiters are installed in the torque shaft assemblies. A lockout indicator senses relative motion between the input and output shafts and pops out when an over torque occurs.

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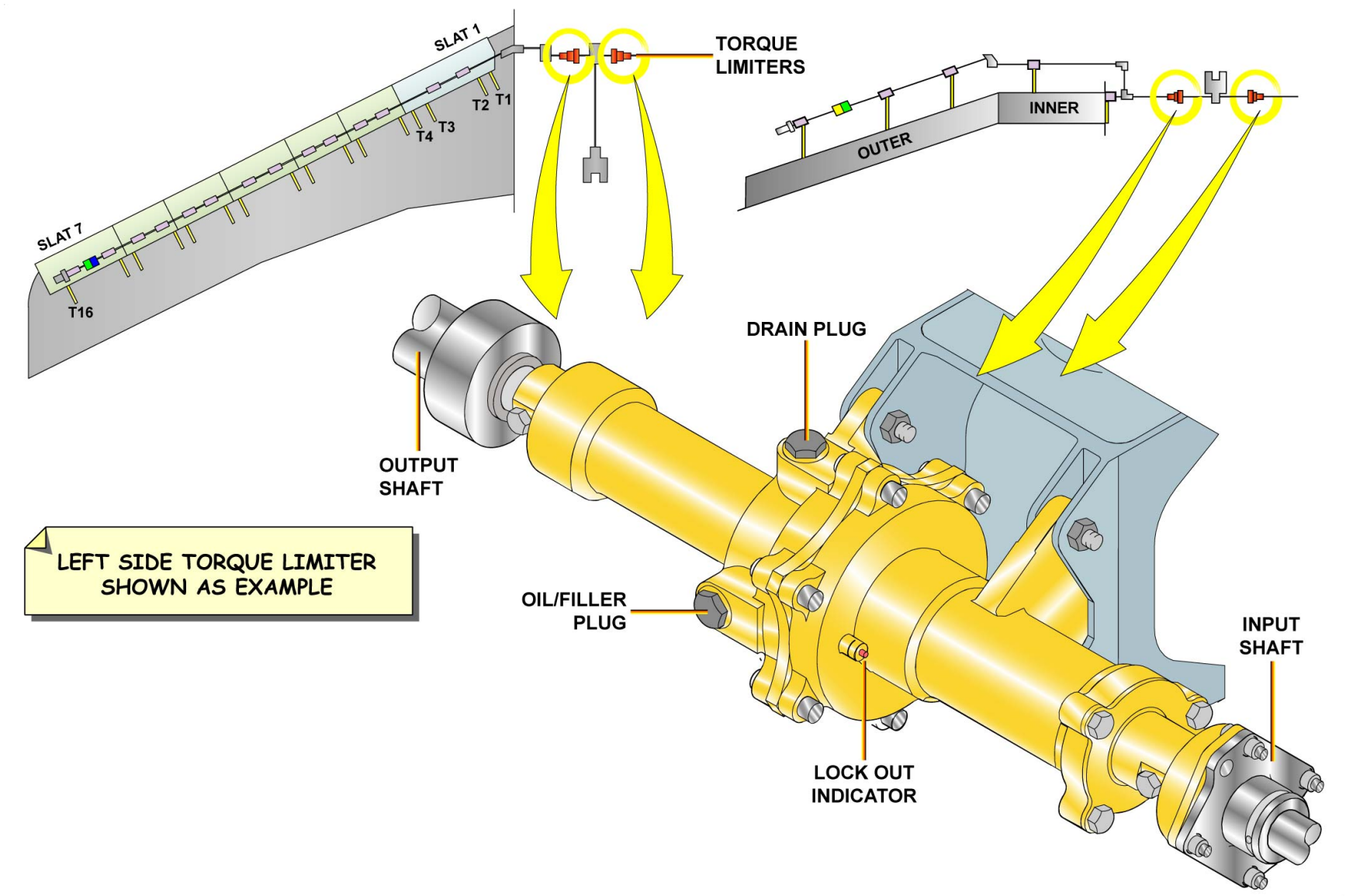

SYSTEM TORQUE LIMITERS

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

TORQUE SHAFTS/SLAT TRACKS

The gearboxes and actuators are driven from the PCU by the torque shafts, which are connected through universal joints and supported in steady bearings. The universal joints permit small angular changes of alignment.
Slat 1 is supported by four tracks but only tracks 2 and 3 are driven. Slats numbers two to seven are supported by two driven tracks.
All tracks are guided in vertical-load and side-load rollers. The tracks are of inverted U section type. They retract through holes in the front spar into a sealed container, which makes a projection into the fuel tank.

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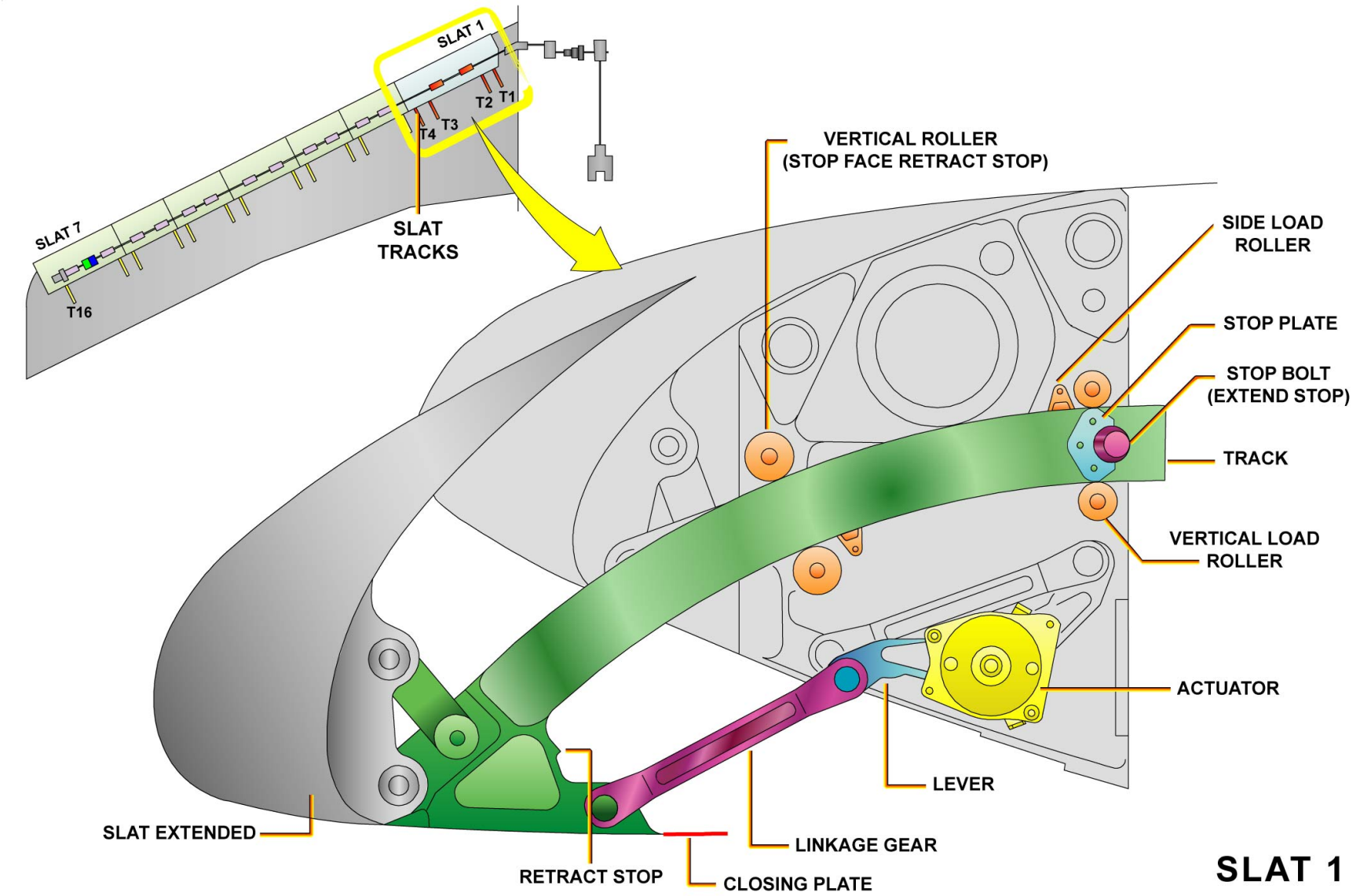

TORQUE SHAFTS/SLAT TRACKS

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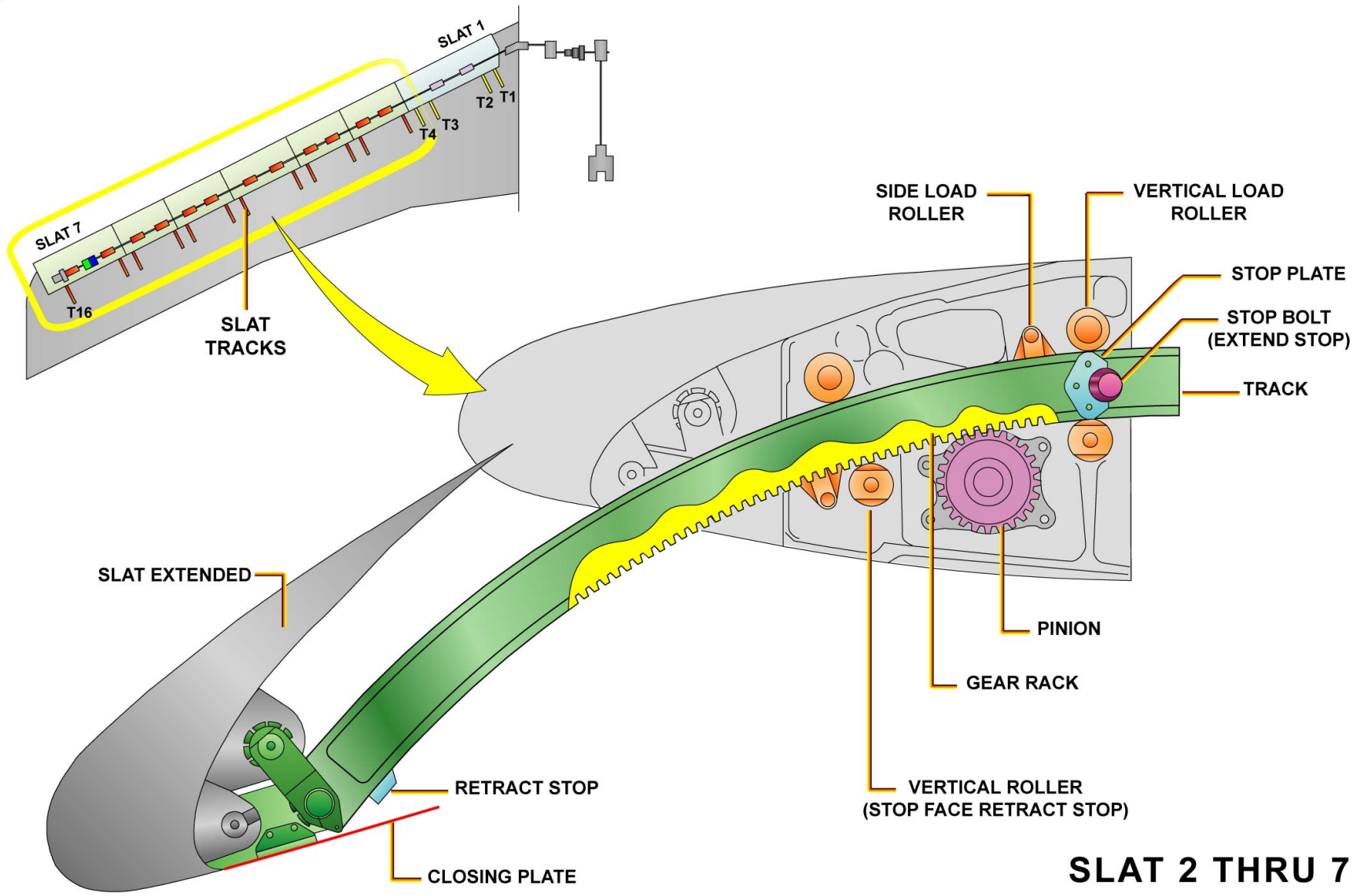

TORQUE SHAFTS/SLAT TRACKS

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

SLAT TYPE A ACTUATOR

Type A actuators, installed on tracks 2 and 3, are coupled to the inboard slat section 1, via a lever/linkage mechanism.
They are larger in size and torque capacity than type B and have an additional stage reduction gear assembly.
An integrated torque limiting assembly protects the structure against torque generated during a system locking or jamming.
It is built with a preloaded setting value related to actuator type and loading requirement and a lock out indicator is provided.
Actuator A is designed for lubrication of the gear stages only, via a grease nipple, the torque limiter section remaining grease free.
A vent assembly allows surplus grease to exude.
It can be interchanged with the blanking plug to be in the lowest point when installing the actuator.
Inspection plugs are provided in the housing, two on the torque limiter chamber and two on the input-gearing chamber, so that whatever the installed position on aircraft, the drainage is at the lowest point. Lubricant condition can also be checked.

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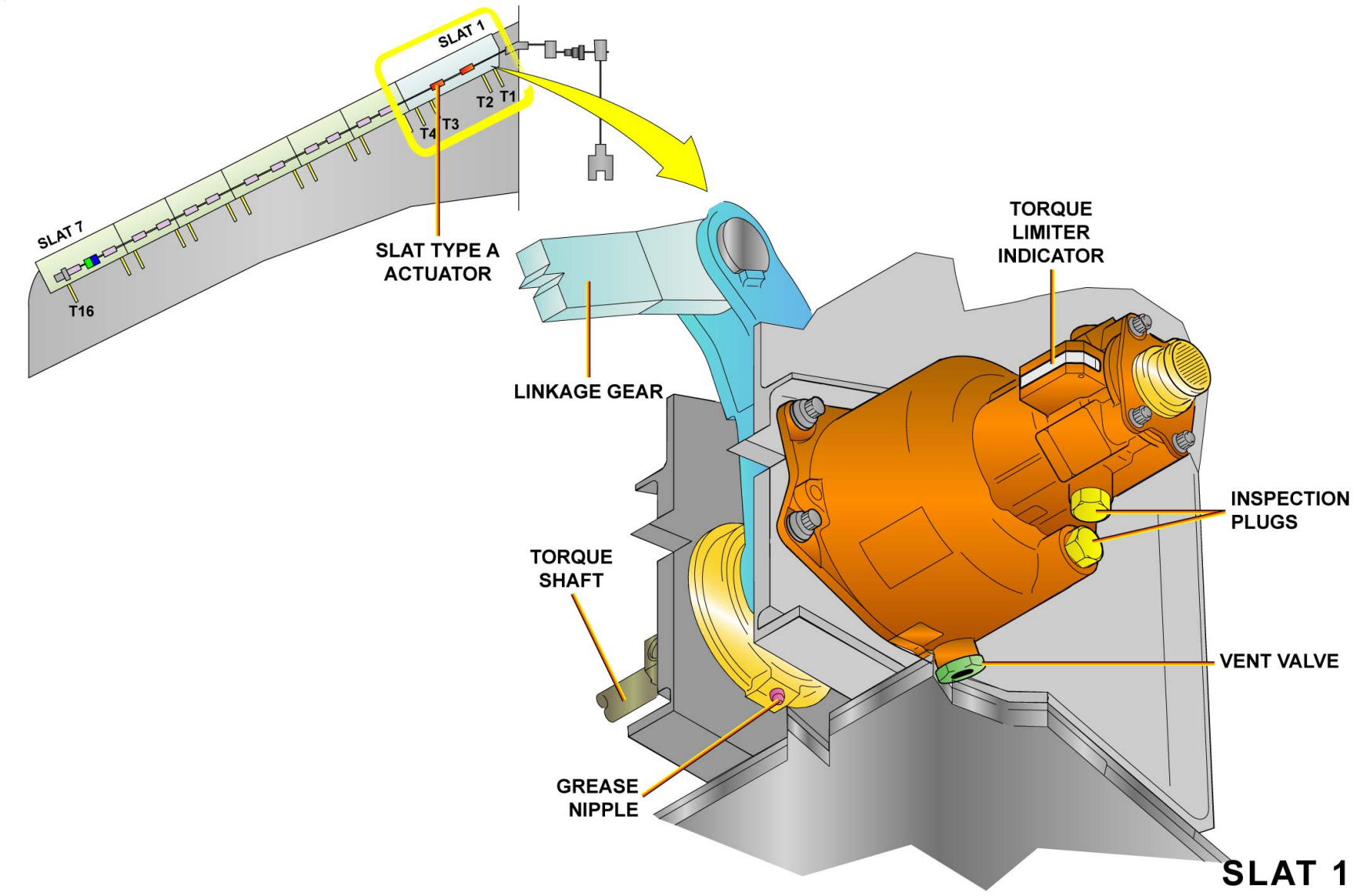

SLAT TYPE A ACTUATOR

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

SLAT TYPE B ACTUATOR

Type B actuators are coupled in pairs to the remaining slat surfaces 2 to 7, via a rack and pinion mechanism.
As type A actuators, they are pure torque devices but are of a different design configuration, being smaller in size and torque capacity and having a simplified gearing arrangement.
As type A actuators, an integrated torque limiter assembly is provided to protect the structure in case of over torque or system jamming.
Actuator B is designed for lubrication of the gear stages only, via a grease nipple, the torque limiter section remaining grease free.
A vent assembly allows surplus grease to exude.
In the torque limiter housing, drainage holes are provided to prevent condensation to collect inside. Drainage points are also provided at the flange-mounting end of the actuator.

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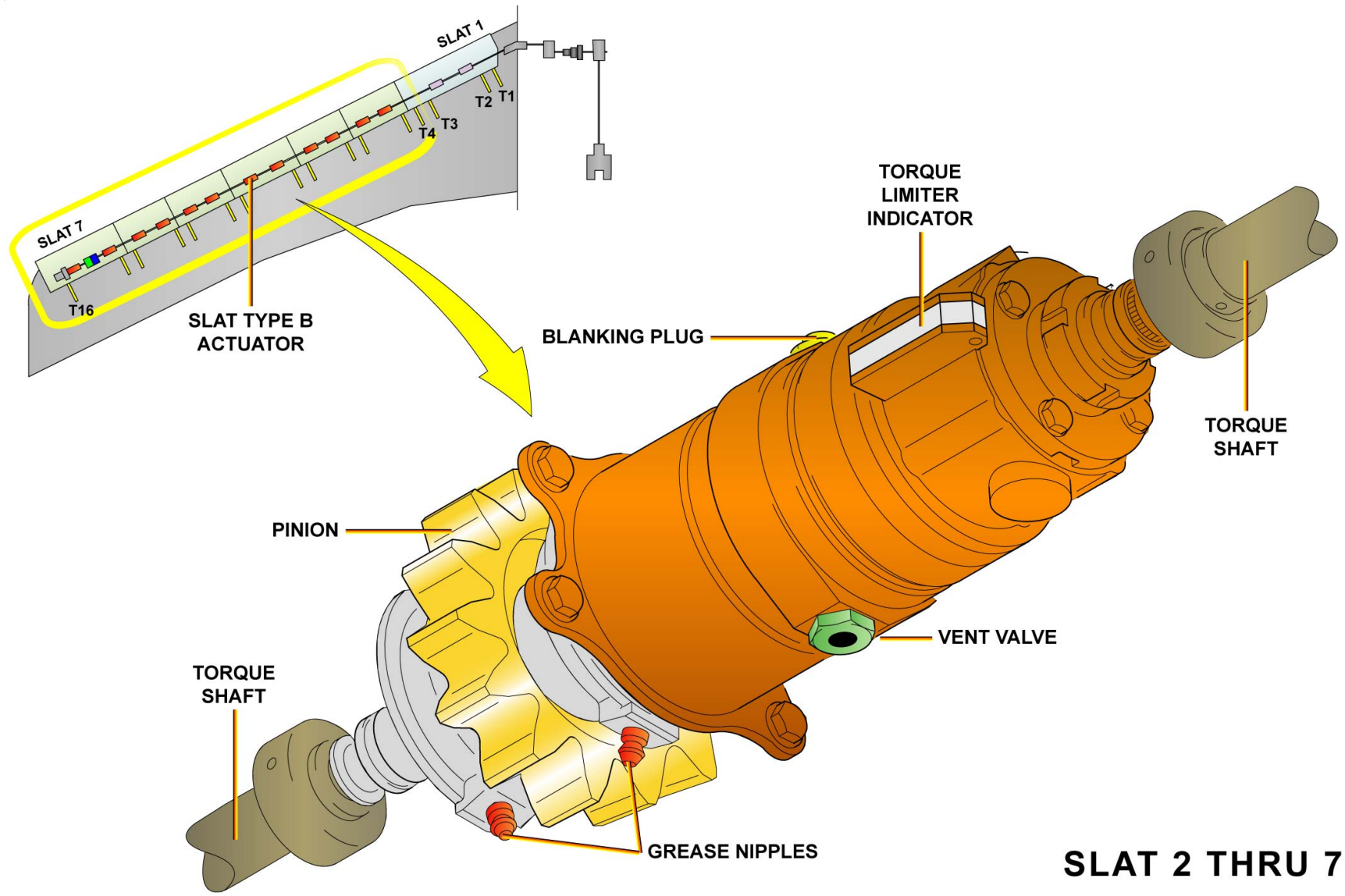

SLAT TYPE B ACTUATOR

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

FLAP TRACKS/FLAP ROTARY ACTUATORS

The flaps are supported on carriages traveling on straight tracks.
The inboard flap is supported on 2 tracks, the outer one on three.
The tracks are connected, with drive arms, to the carriages.
They are of a similar construction except track 1 which is attached to the fuselage and located in the wheel well.
The reduction ratio rotary actuators mounted on the track beams drive the flaps.
Each actuator has an output arm attached either directly to the flap drive linkage (station 1), or to an extension arm connected to the drive linkage.
There are two types of rotary actuator:
- Type A is used at stations 1 and 5.
- Type B, which is of a larger diameter is installed at stations 2, 3 and 4 because of higher aerodynamic loads at these points.

Each actuator has also two possible vent positions, the unused one being blanked off.
The vent position depends on the actuator and each actuator casing is marked appropriately.
The actuators are designed to be "re greased" periodically through a grease nipple after removal of the vent/drain plug.

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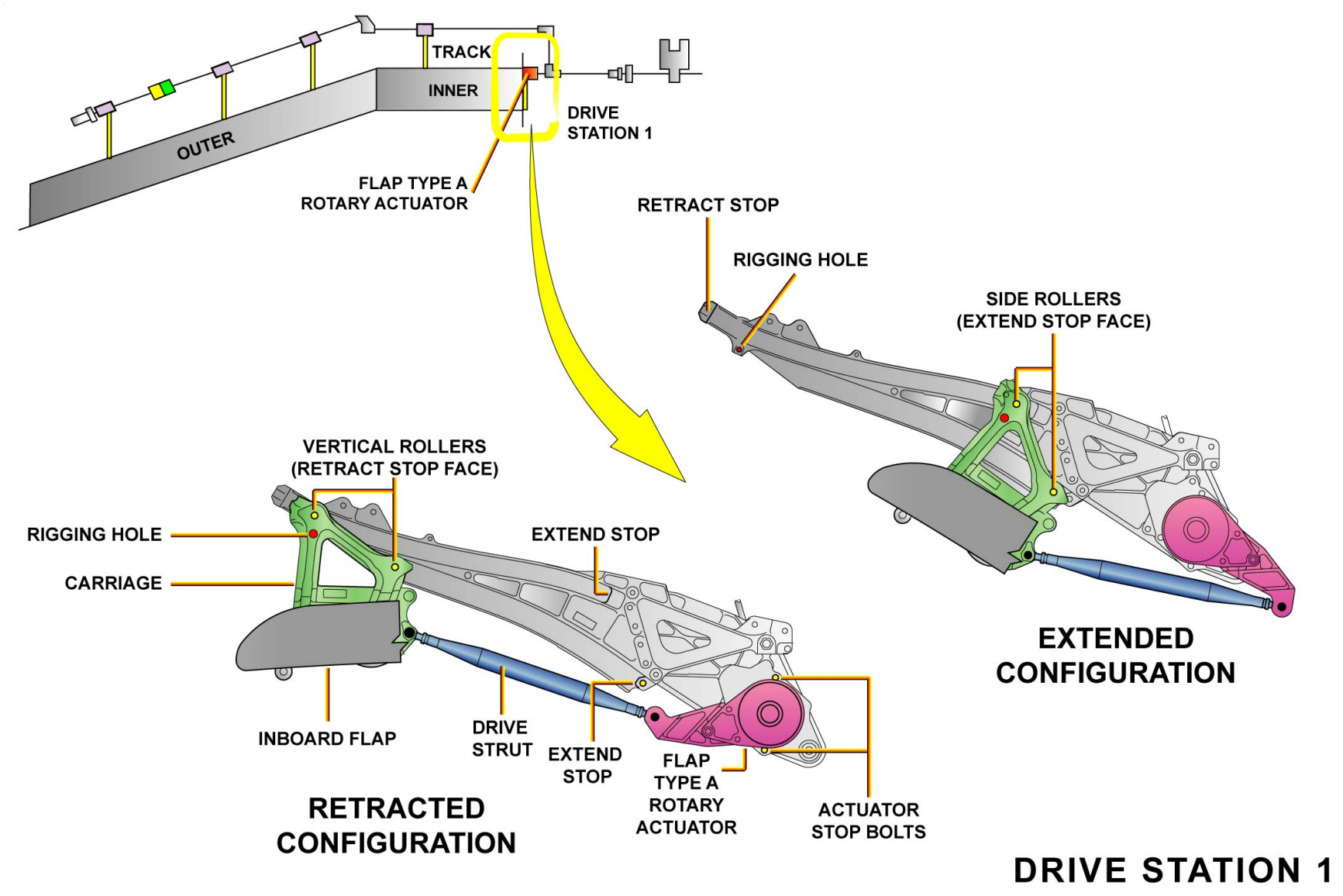

FLAP TRACKS/FLAP ROTARY ACTUATORS

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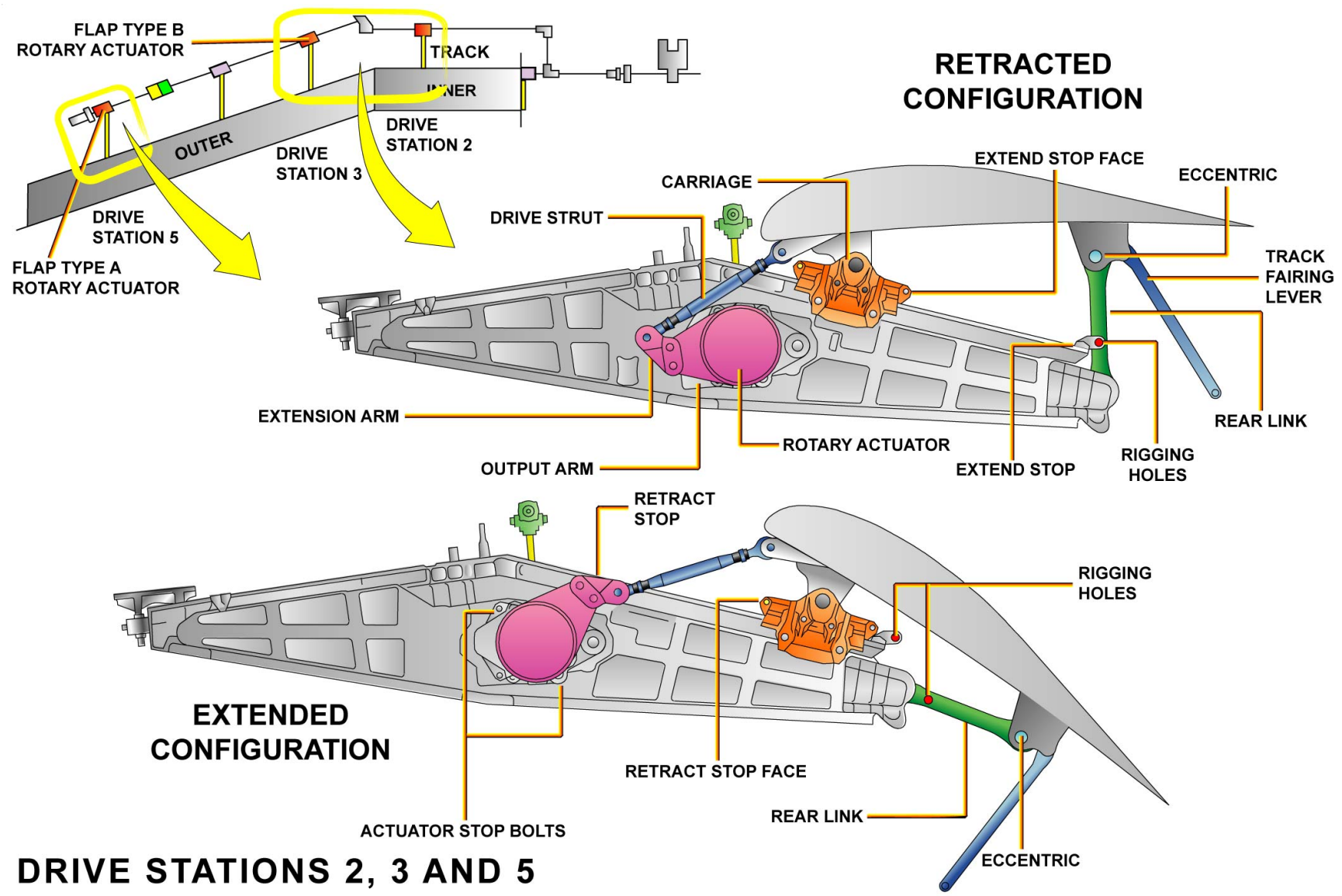

FLAP TRACKS/FLAP ROTARY ACTUATORS

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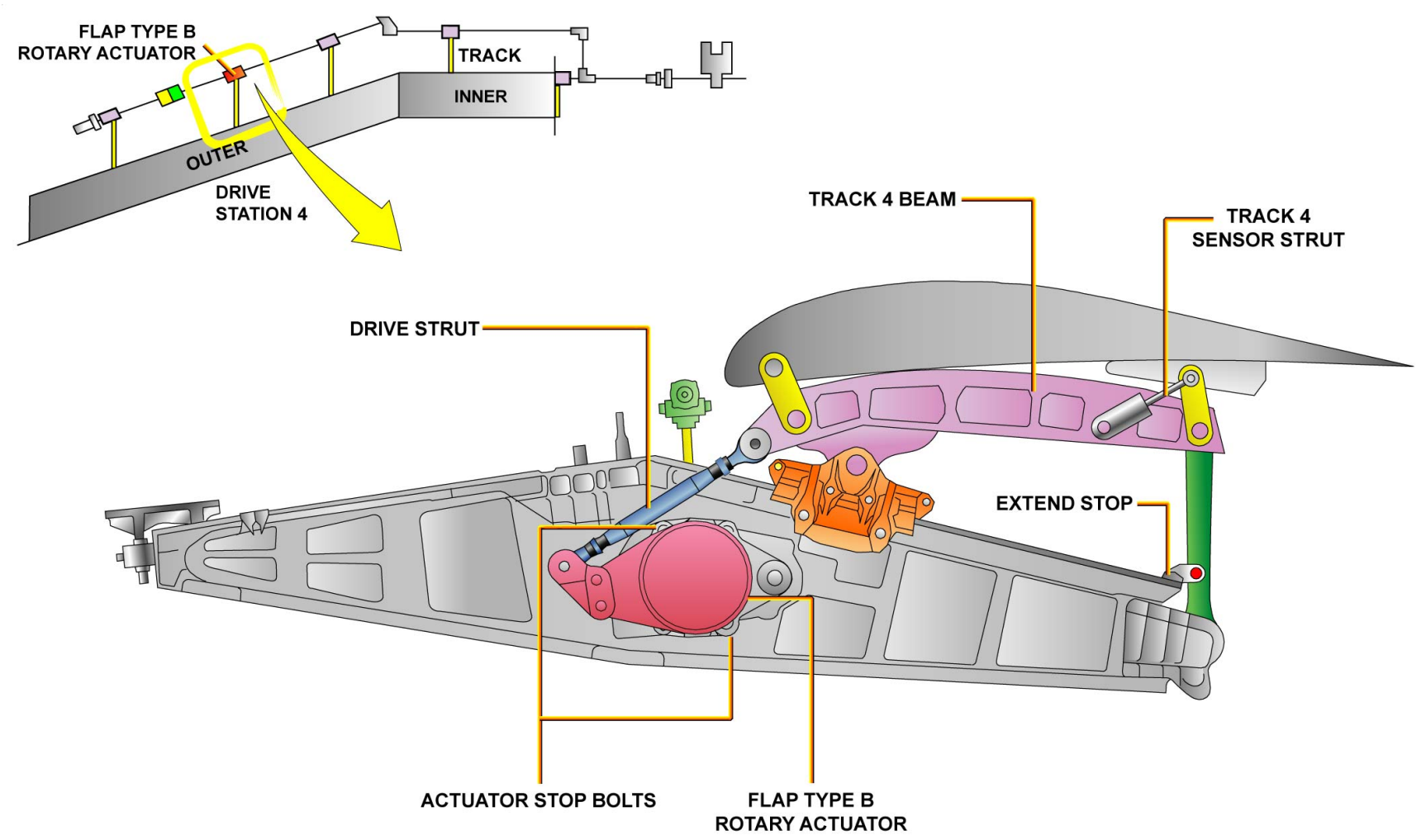

DRIVE STATION 4

FLAP TRACKS/FLAP ROTARY ACTUATORS

SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

FLAP INTERCONNECTING STRUT

The interconnecting strut takes up the differential movement between the inner and outer flaps.
In the event of a disconnect (attach breakdown) in drive stations 1, 2 or 3, the disconnect sensors send data to the SFCCs, to indicate that the limit of differential movement has been exceeded.
In that case, the interconnecting strut gives an alternative load path for the flap drive.
The flap interconnecting strut has:
- a housing
- an actuating rod
- a target
- a ball piece
- a sleeve

The target is at the end of the actuating rod.
The two sensors are on the housing to agree with the normal position of the target.
If the target moves out of the normal limits, the sensors send a target far signal to their related SFCCs.

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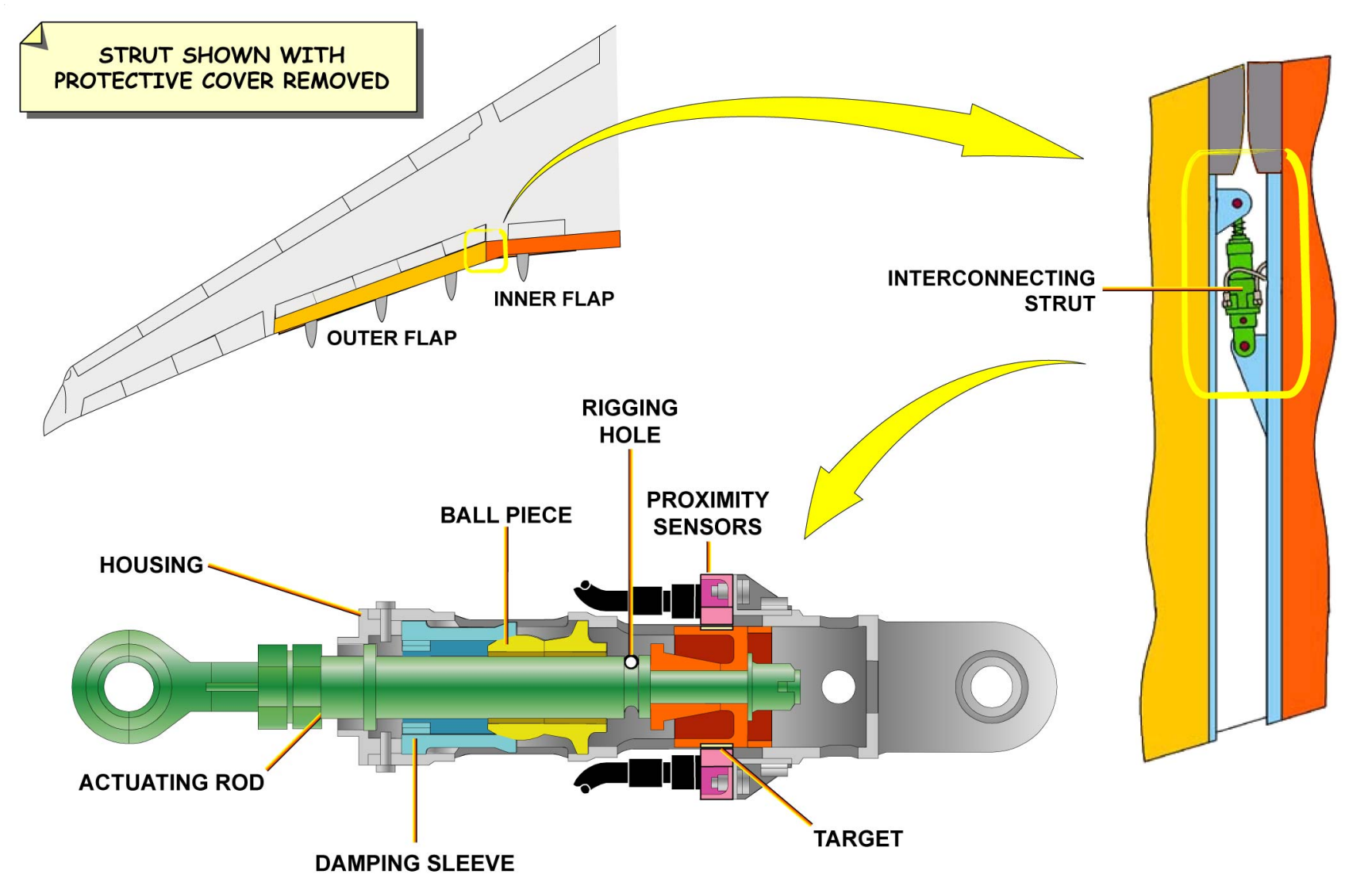

FLAP INTERCONNECTING STRUT

G94093341 - GAUT0T0 - FM27D6000000002

SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

FLAP TRACK 4 SENSOR STRUT

The track 4 sensor strut provides information about the relative position of the outer flap to the SFCCs.
Flap track 4 fault is defined as the exceeding of the normal relative movement between the track 4 beam assembly and the flap.
If the drive at station 4 or 5 becomes disconnected, the beam assembly is displaced relative to the flap.
This causes a relative movement in the extend or compression direction between the actuating rod and the sensor housing.
If the target moves out of the normal limits, the sensors send a target far signal to their related SFCCs.

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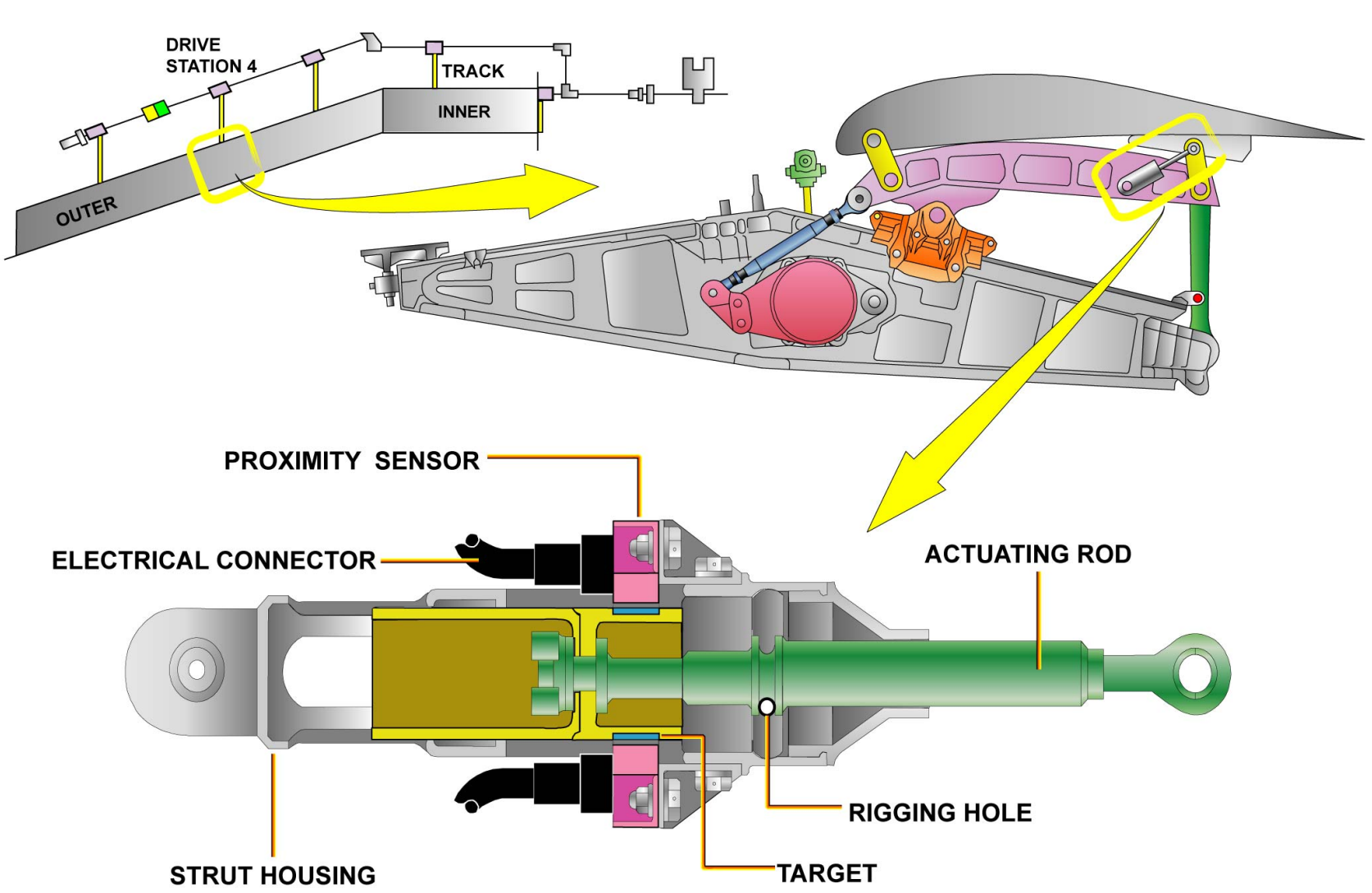

FLAP TRACK 4 SENSOR STRUT

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

WING TIP BRAKE (WTB)

GENERAL VIEW

This is a general view of a Wing Tip Brake (WTB).

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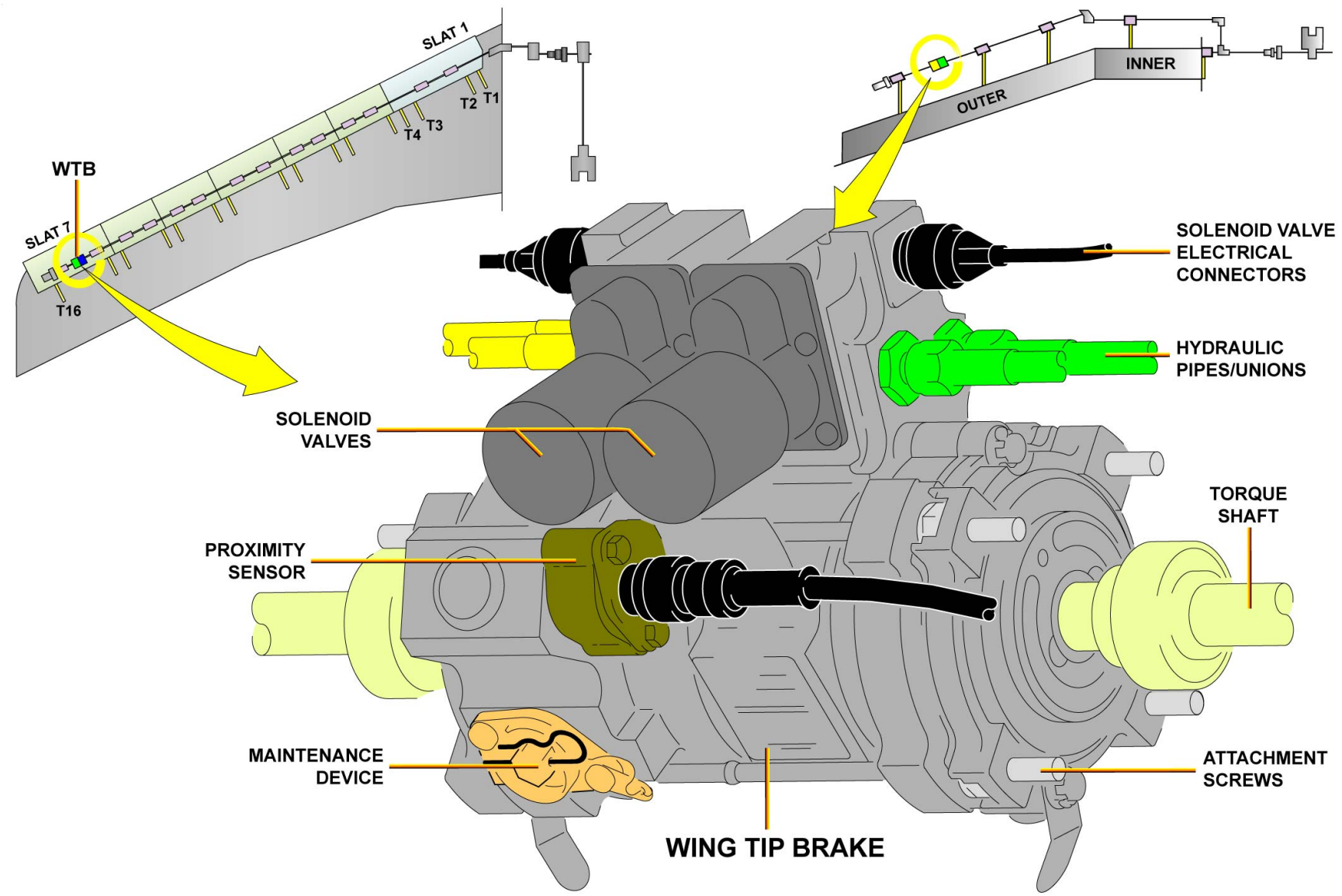

WING TIP BRAKE (WTB) - GENERAL VIEW

G9409341 - GAUT0T0 - FM27D6000000002

SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

WING TIP BRAKE (WTB) (continued)

DESCRIPTION

The brake is a "pressure off brake" using a multi plate friction device operated by a spring pack.
Dual hydraulic pistons controlled by two electro hydraulic solenoid valves perform brake release.
The two hydraulic circuits are separated and either one can release the brake.
Brake position is monitored by a proximity sensor used on ground for the WTB engagement test performed from the MCDU.

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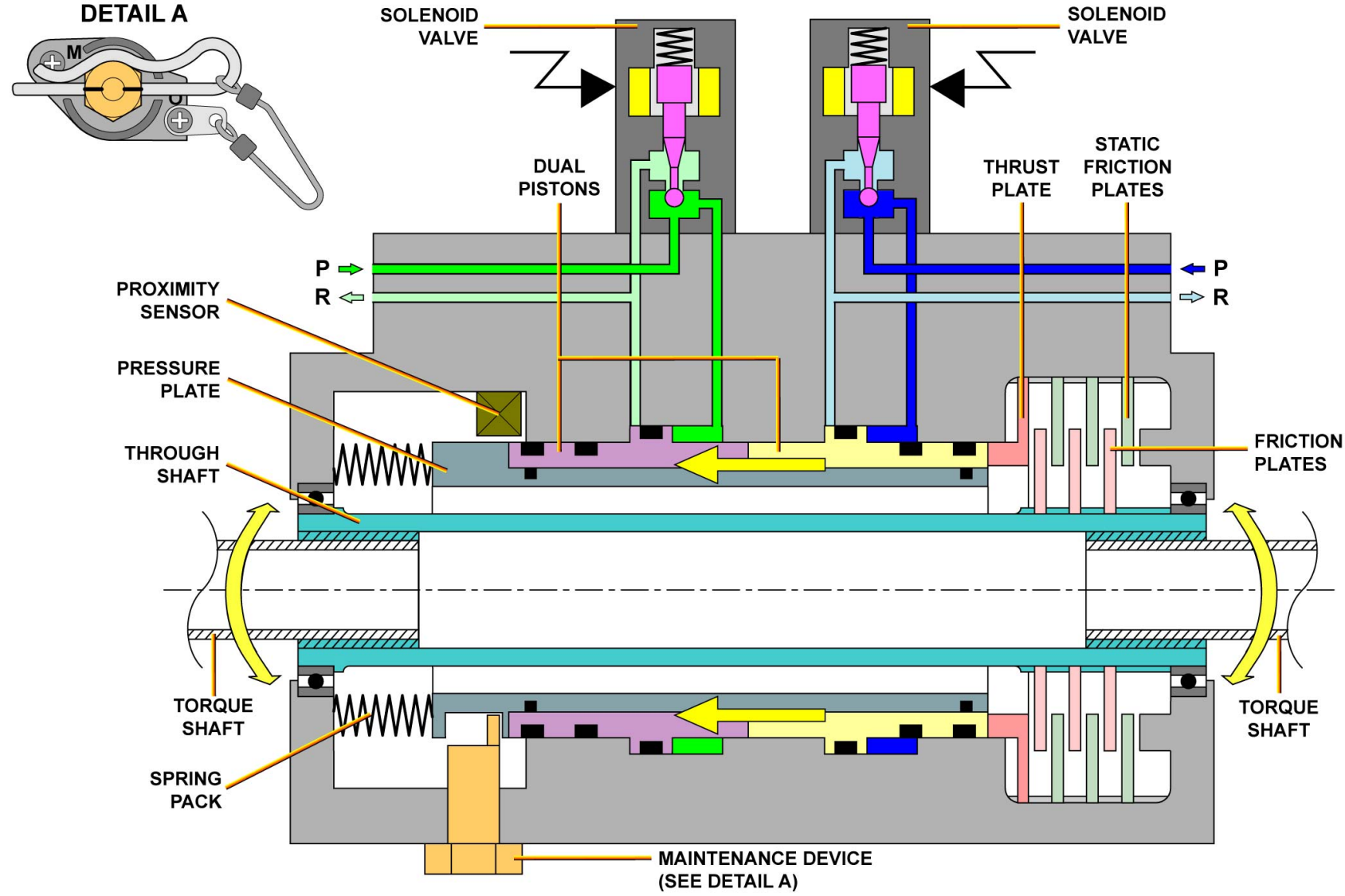

WING TIP BRAKE (WTB) - DESCRIPTION

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SECONDARY CONTROL SLAT & FLAP TRANSMISSION D/O (3)

WING TIP BRAKE (WTB) (continued)

MAINTENANCE DEVICE

A manual brake release mechanism is provided for maintenance operation.
Manual release is achieved by rotating the manual release shaft in an anticlockwise direction.
- first withdraw the spring cotter pin, then rotate the release shaft until the indicator arm moves to the "M" (Maintenance) position.
At this point, the brake is off and the transmission through shaft can be rotated.
-Setting the brake to the operational position again is performed by rotating the release shaft clockwise, until the indicator arm is in the "0" (Operational) position.
The release shaft must be in the correct operational position, so that the spring cotter pin can be re-inserted.

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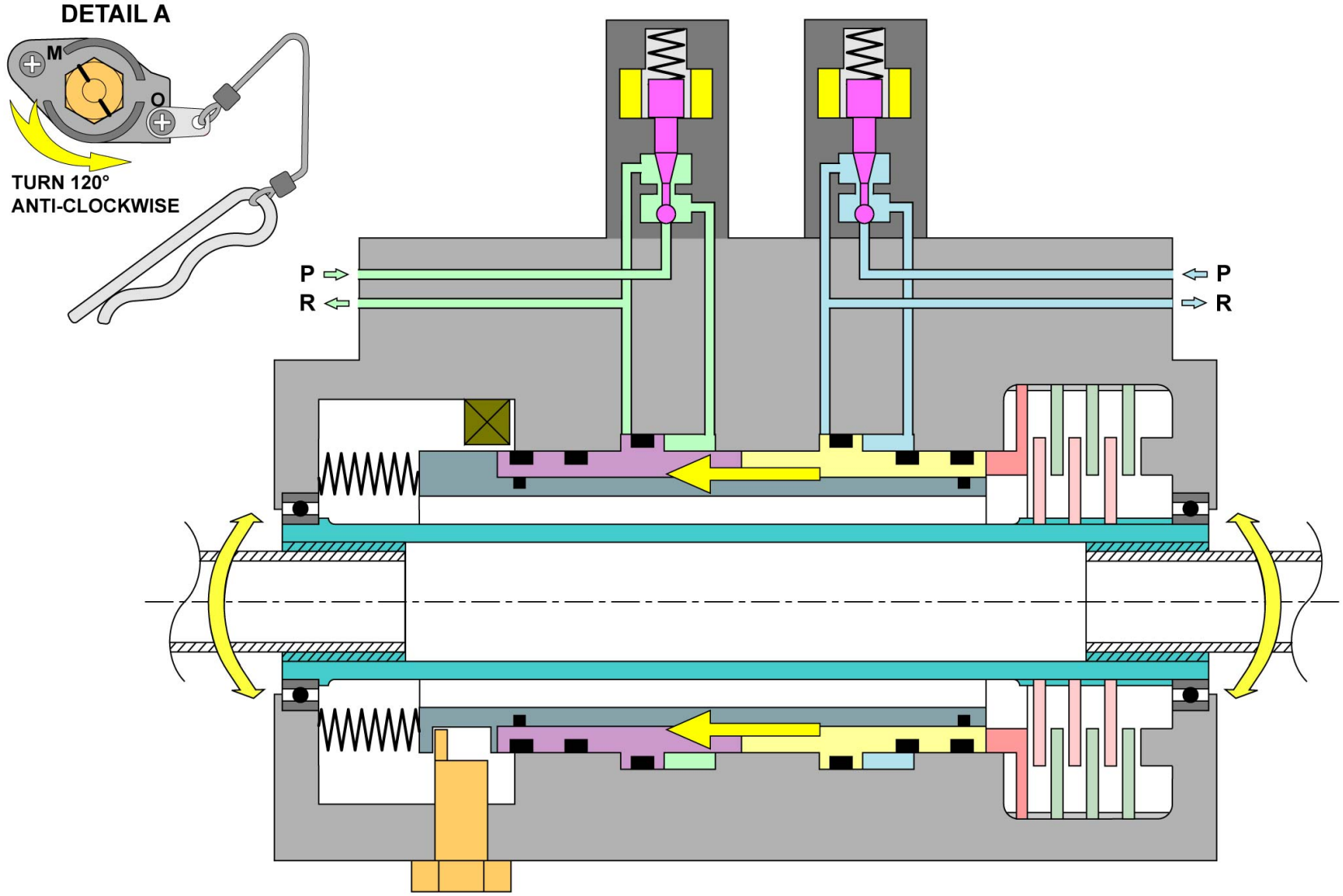

WING TIP BRAKE (WTB) - MAINTENANCE DEVICE

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

GENERAL

The racks in the forward avionics compartment contain the two SFCCs. The SFCCs have power supplies with no relation to each other. Each SFCC has the same function and includes one flap channel and one slat channel. Each channel has 2 lanes. Each valve block has its own different hydraulic supply.
The requirements for normal operation are: aircraft electrical network available, circuit breakers closed and corresponding hydraulic systems pressurized. Thus SFCCs energize the WTB solenoids and WTB are released.
Flaps operation will be explained, Slats operation is similar in principle.
The slat/flap control lever is located in the cockpit. There are five possible positions for the lever (identified as 0, 1, 2, 3 and FULL) which correspond to different slat/flap positions.
When the slat/flap control lever is set to an extended position, The CSU changes the mechanical command signal from the slat/flap control lever into an electrical signal to SFCC1 and SFCC2.

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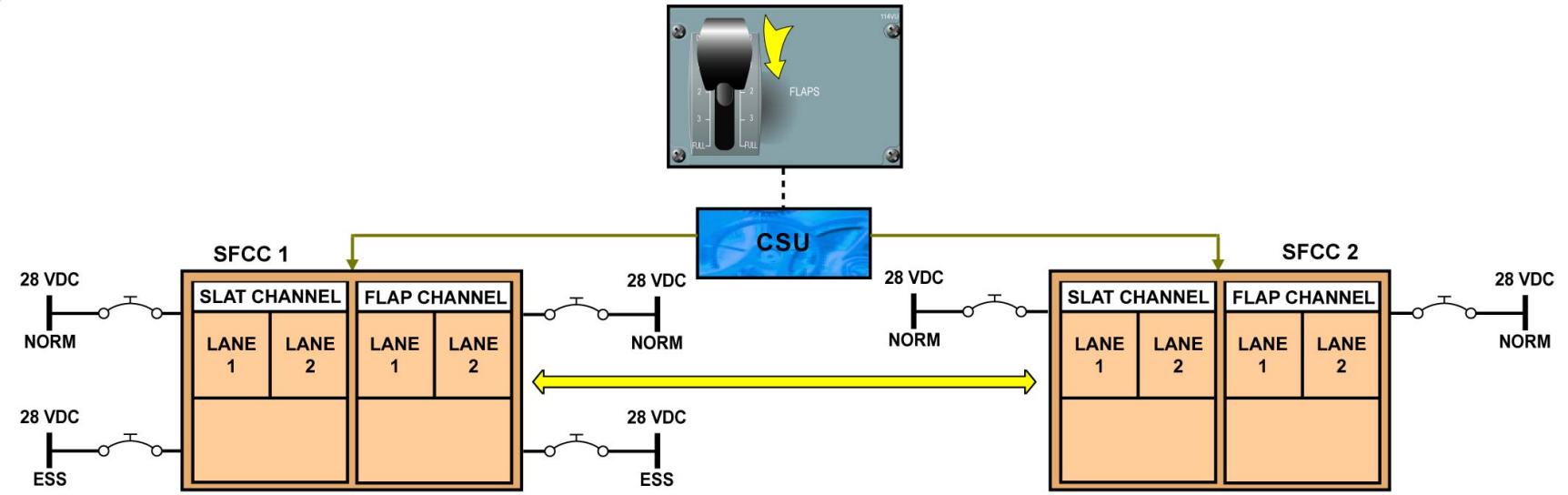
FLAPS
CSU
SFCC 1
SFCC 2
28 VDC
NORM
28 VDC
ESS
SLAT CHANNEL
FLAP CHANNEL
LANE 1
LANE 2
LANE 1
LANE 2
28 VDC
NORM
28 VDC
ESS
28 VDC
NORM
SLAT CHANNEL
FLAP CHANNEL
LANE 1
LANE 2
LANE 1
LANE 2
28 VDC
NORM

GENERAL

SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

PCU STANDBY MODE

During the normal operation SFCC1 and SFCC2 compare the position signals from the CSU and FPPU. The FPPU installed on the PCU, gives information on the position of the transmission to both SFCCs.

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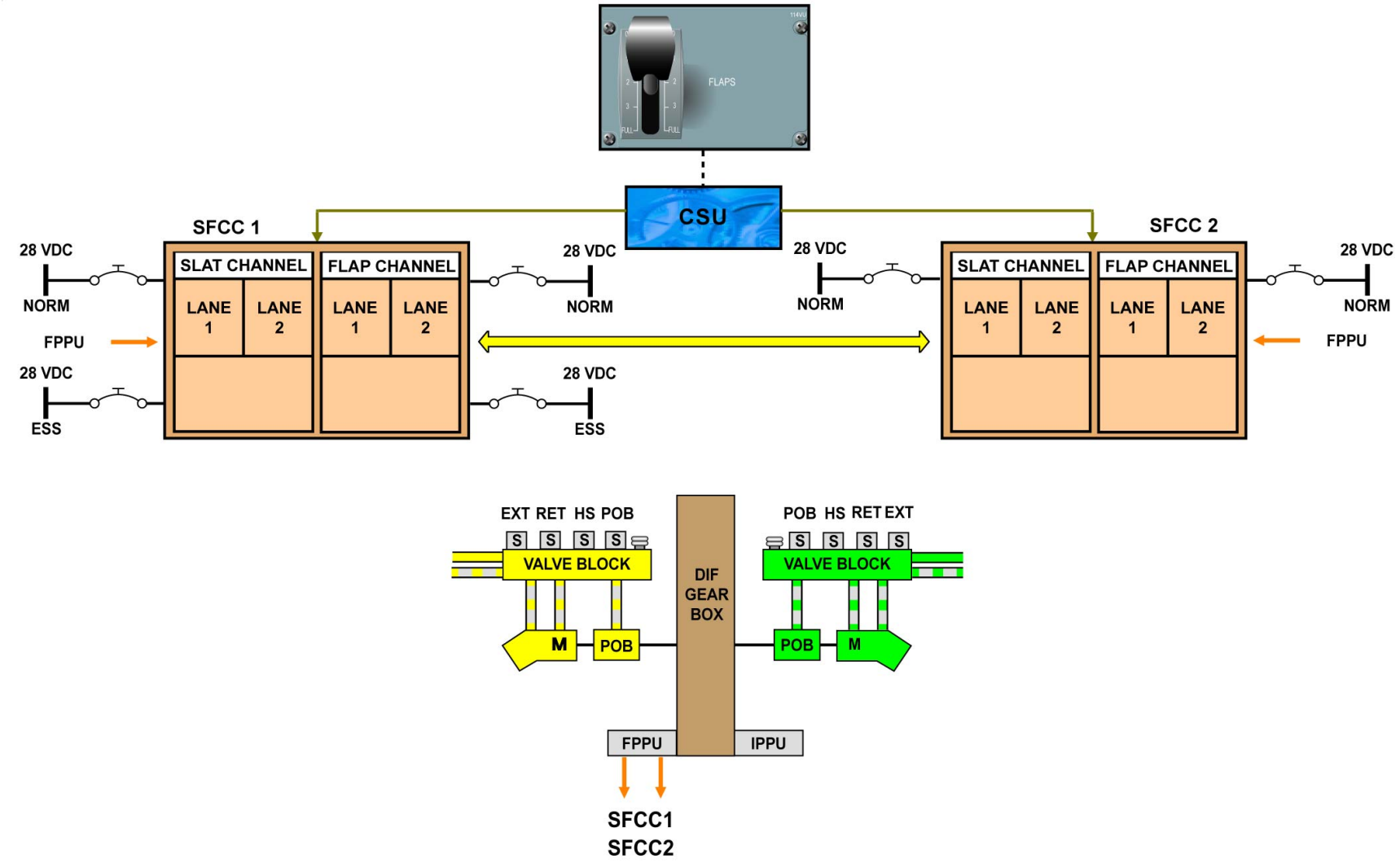

PCU STANDBY MODE

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

PCU START-UP SEQUENCE

When there is a difference between the CSU and FPPU signals, SFCCs send discrete signals to their related solenoid valves mounted on the PCU valve block to achieve movement. The SFCCs take also into account the APPUs and ADIRS inputs. Both lanes in a channel must agree to send signals to their valve blocks.

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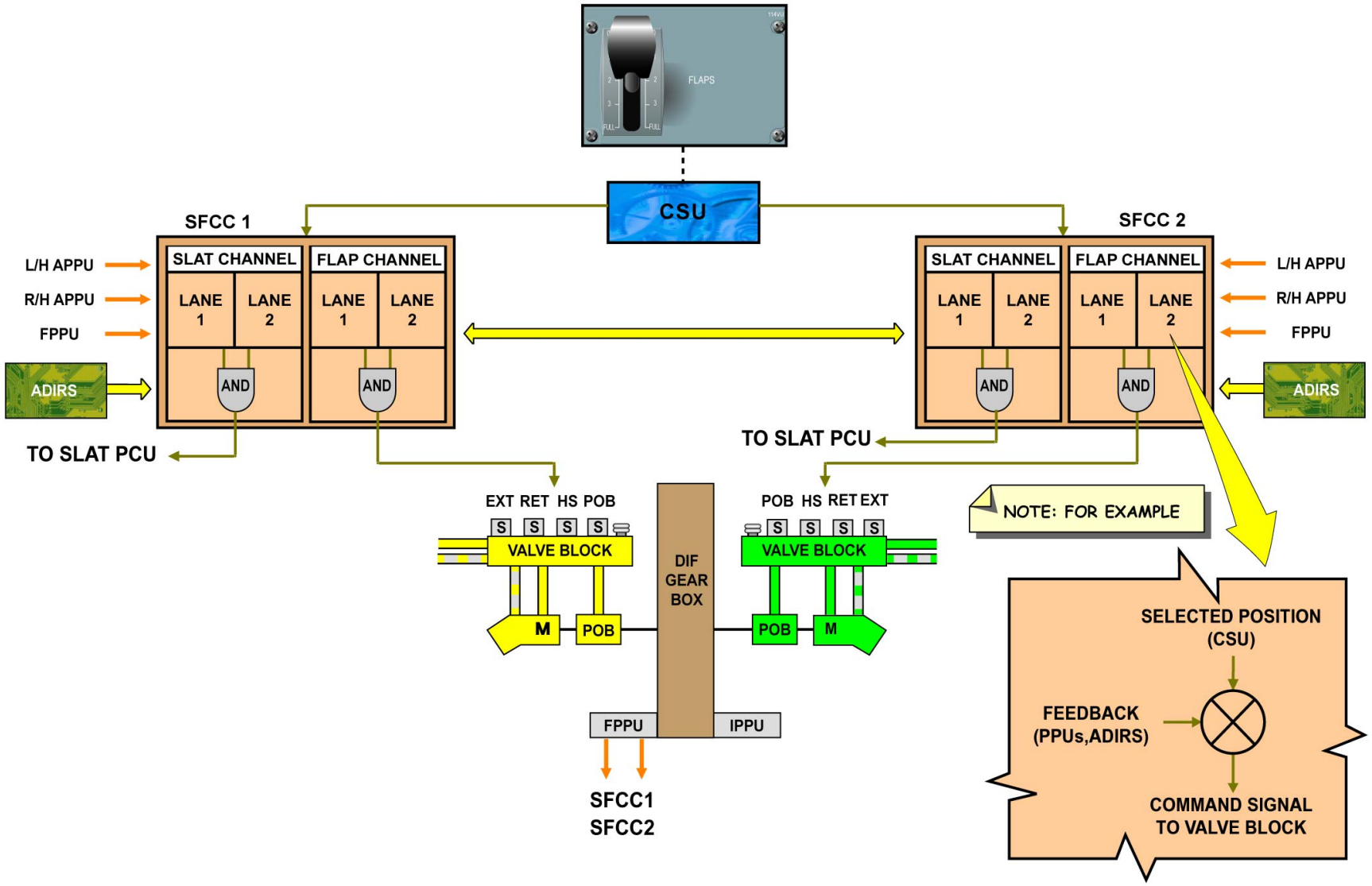

PCU START-UP SEQUENCE

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

POWER CONTROL UNIT SHUT-DOWN SEQUENCE

The two SFCCs monitor:
- the operation of the transmission system,
- the condition of the PCU and WTBs
- the position of the flaps and slats.

They get signals from:
- the FPPU, the two APPU,
- the PCU valve blocks pressure switches,
- the interconnecting strut switches,
- the track 4 proximity switches.

They identify component failures of the transmission and the control systems.

When the SFCCs receive a command to extend the flaps, they energize the extend solenoid valve of each PCU valve blocks. A pressure switch mounted on each valve block monitors the main control valve operation. After this, the POB solenoid valves are energized. The POBs are released and the motors run.

Torque shafts and gearboxes transmit the power from the PCU to the drive stations. Down drive gearboxes, downdrive shafts, input gearboxes and cross shafts at the drive stations transmit the power to rotary actuators. The torque limiters in the input gearboxes prevent the transmission of too much torque to the rotary actuators and the aircraft structure. The rotary actuators move the carriages on which the flaps are installed. When the motor operates with a certain speed the High-speed solenoid valves are energized.

As the flaps get near to the selected position, the High-speed solenoid valves are de-energized. When the flaps get to the specified position, the POB and Extend solenoid valves are de-energized. The POBs are applied and the motors stop.

The IPPU installed on the PCU indicates the position and correct operation. It sends signals to the Flight Warning Computers. The FWCs transmit this information to the Electronic Instrument System (EIS). The EIS displays the position of the flaps on the EWD.

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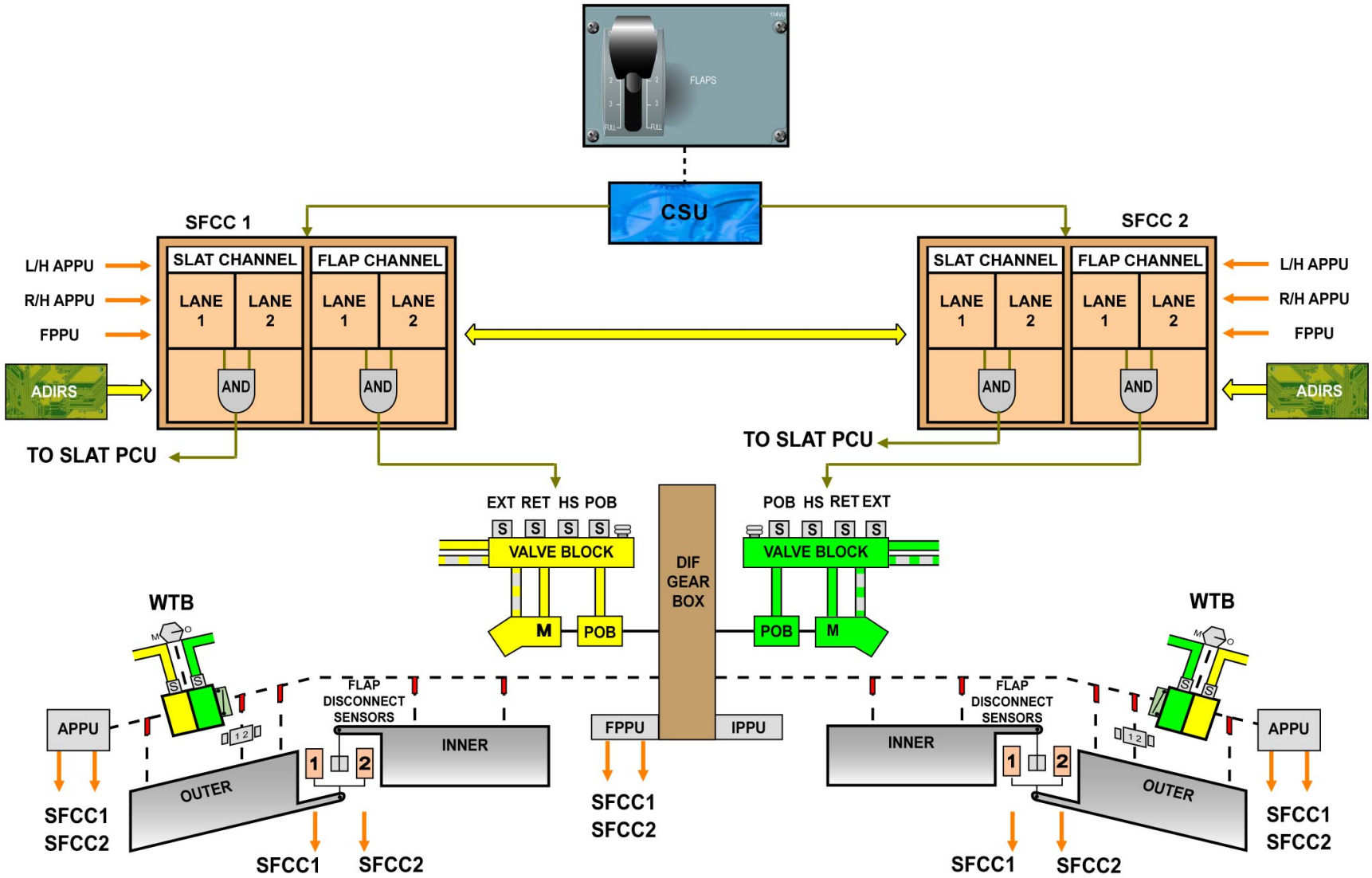

POWER CONTROL UNIT SHUT-DOWN SEQUENCE

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

VALVE BLOCK OPERATION

When the SFCCs receive a command to extend the flaps:
They energize the extend solenoid valve of each PCU valve blocks
The energized extend solenoid valve let hydraulic fluid flow to one end of the spool of the PCU control valves (referred to the spool control valve).
The control valve moves from the neutral position and lets hydraulic fluid flow to:
-the POB solenoid valve,
-the pressure switch,
-the extend side of the motor.
A signal from each pressure switch to the SFCCs starts another signal which energize the POB solenoid valves:
- the POB releases,
- the motor moves the differential gearbox in the low-speed mode,
-the flaps extend.
When the motor operates with a certain speed, SFCCs energize each high-speed solenoid valves and the subsequent actions occur:
- the pressure maintaining valves are turned on,
- the control valves move further from the neutral position,
- the flow of hydraulic fluid to the motor increases,
-the motors operate at high speed.
As the flaps get near to the selected position:
- SFCCs de-energize each high-speed solenoid valve,
- the control valves move in the direction of the neutral position,
- the flow of hydraulic fluid to the motors decrease,
- the motors return to the low-speed mode,
- the flaps operate at a lower speed.
When the flaps get to the selected position:
- SFCCs de-energize each POB solenoid valve,
- the motors and the input shaft of the differential gearbox (and thus the flaps) are stopped.
- SFCCs de-energize each retract solenoid valves,
the spring moves each control valves to the neutral position.
For retraction, the operation is similar in principle

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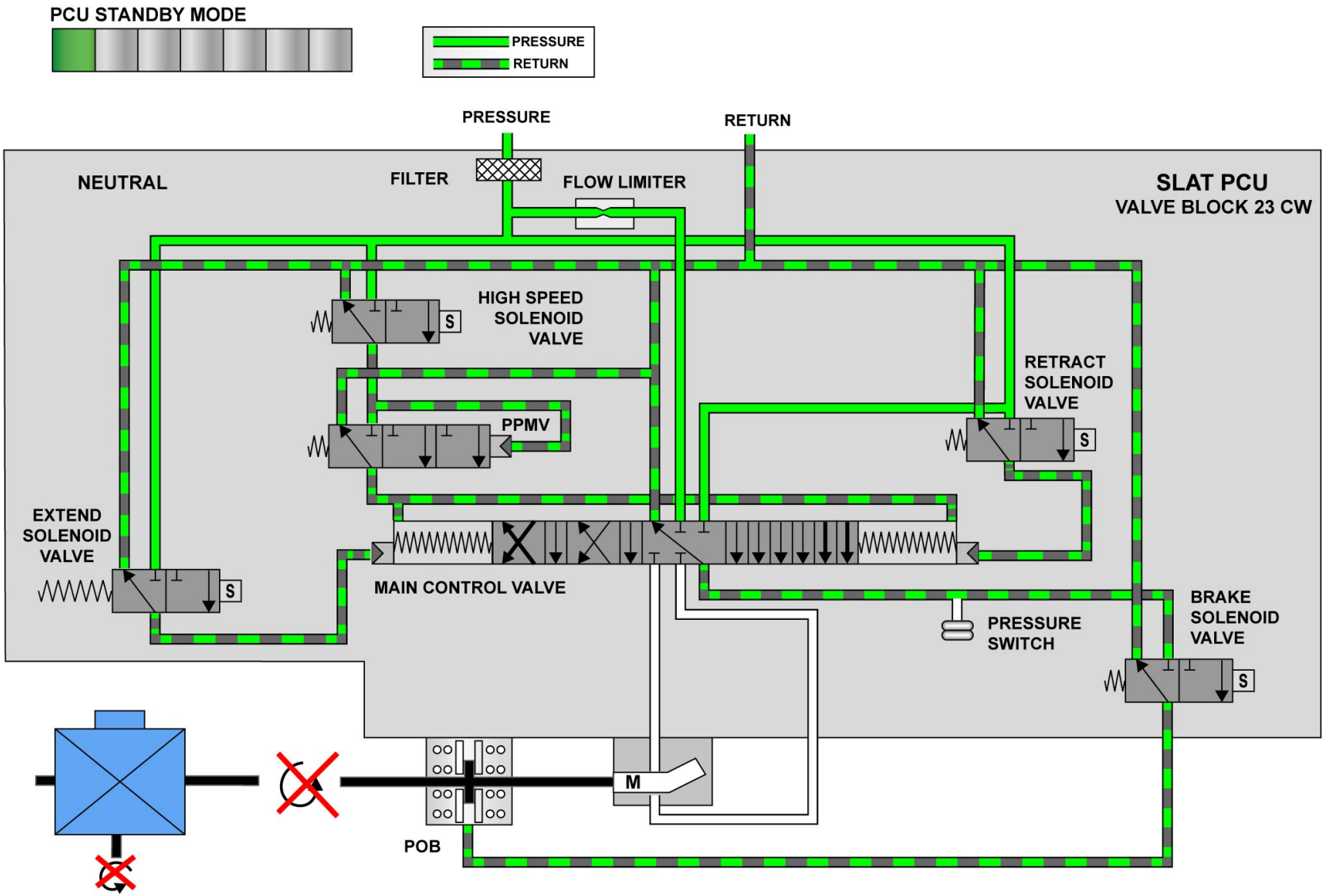

VALVE BLOCK OPERATION

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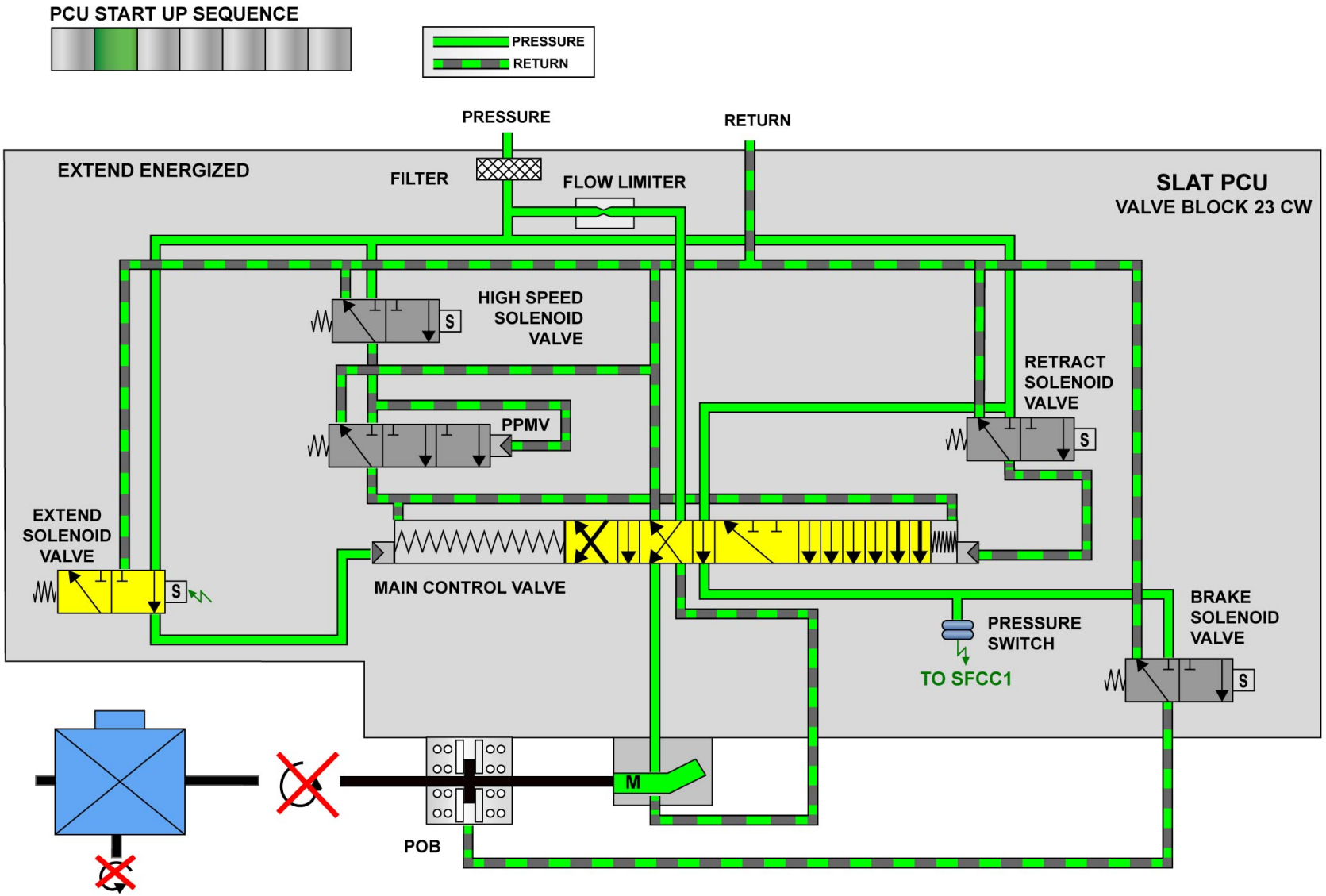

VALVE BLOCK OPERATION

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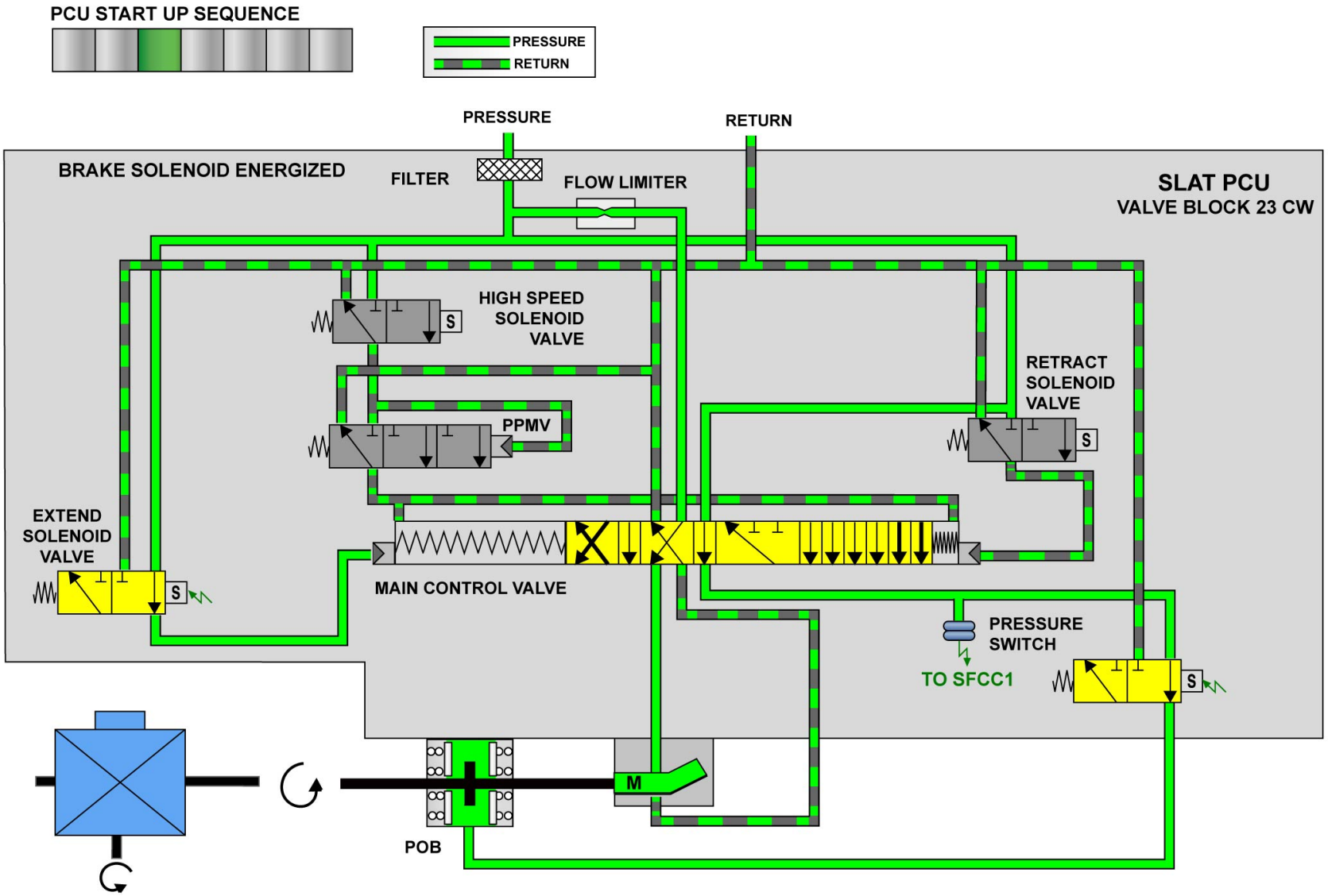

VALVE BLOCK OPERATION

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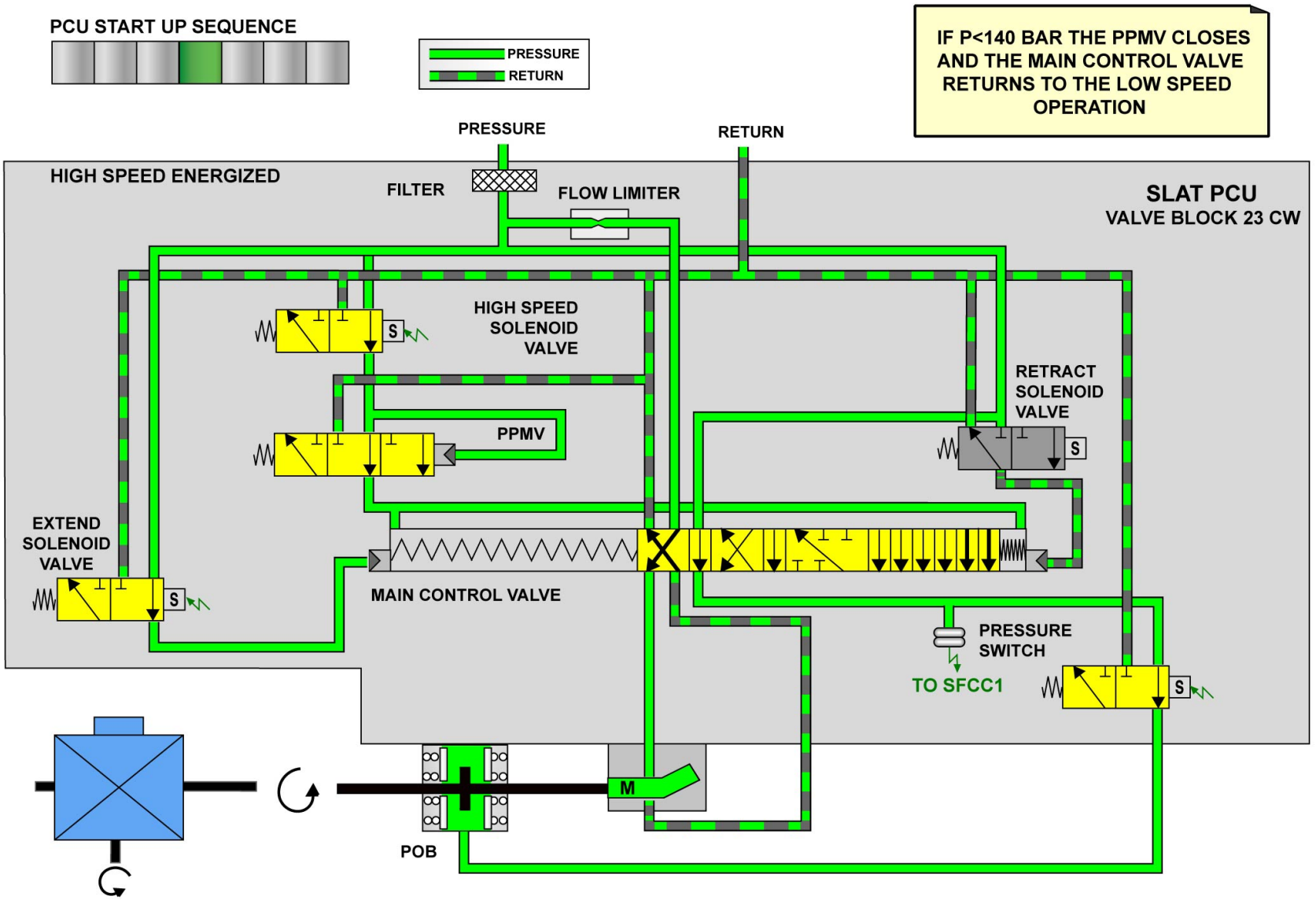

VALVE BLOCK OPERATION

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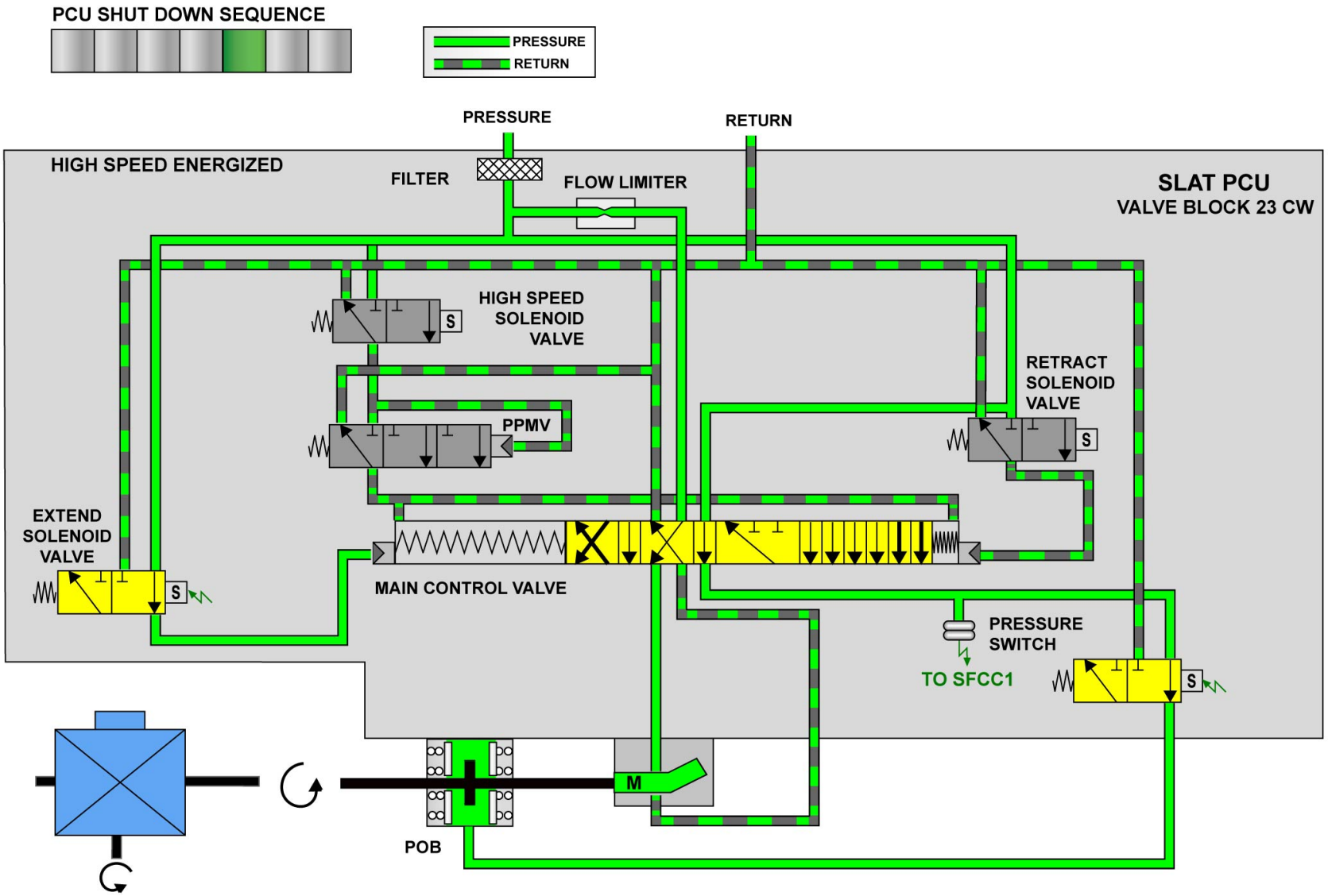

VALVE BLOCK OPERATION

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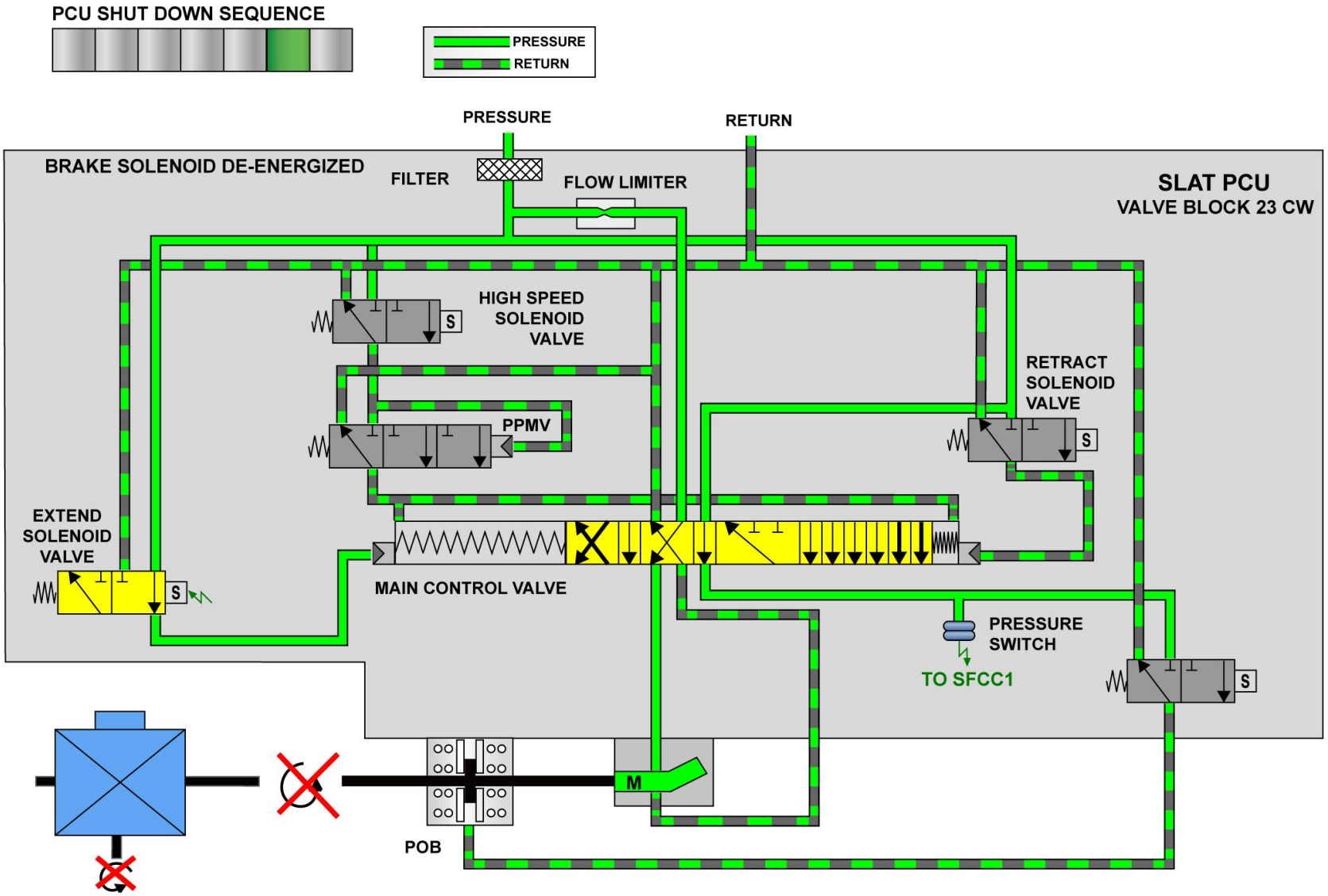

VALVE BLOCK OPERATION

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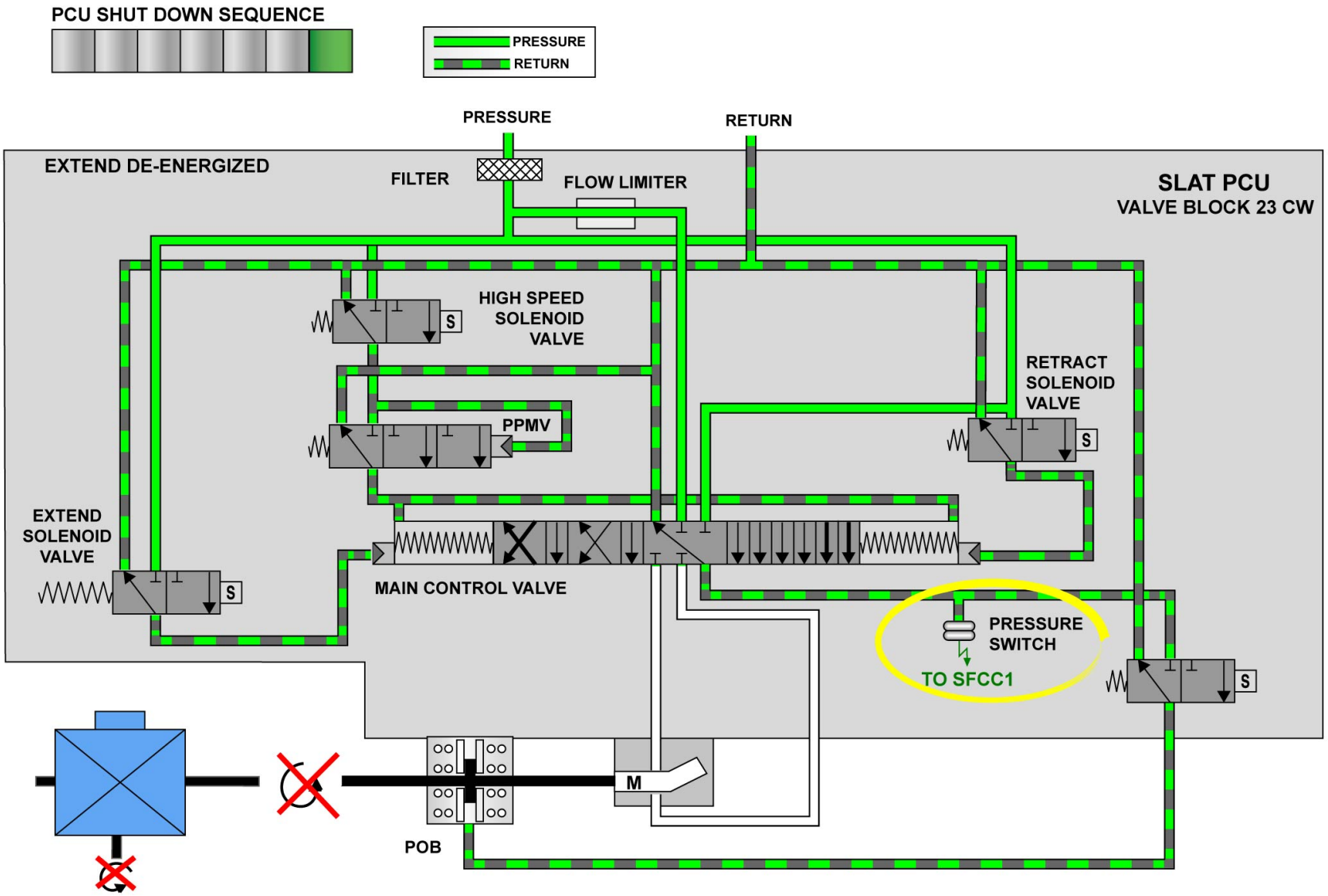

VALVE BLOCK OPERATION

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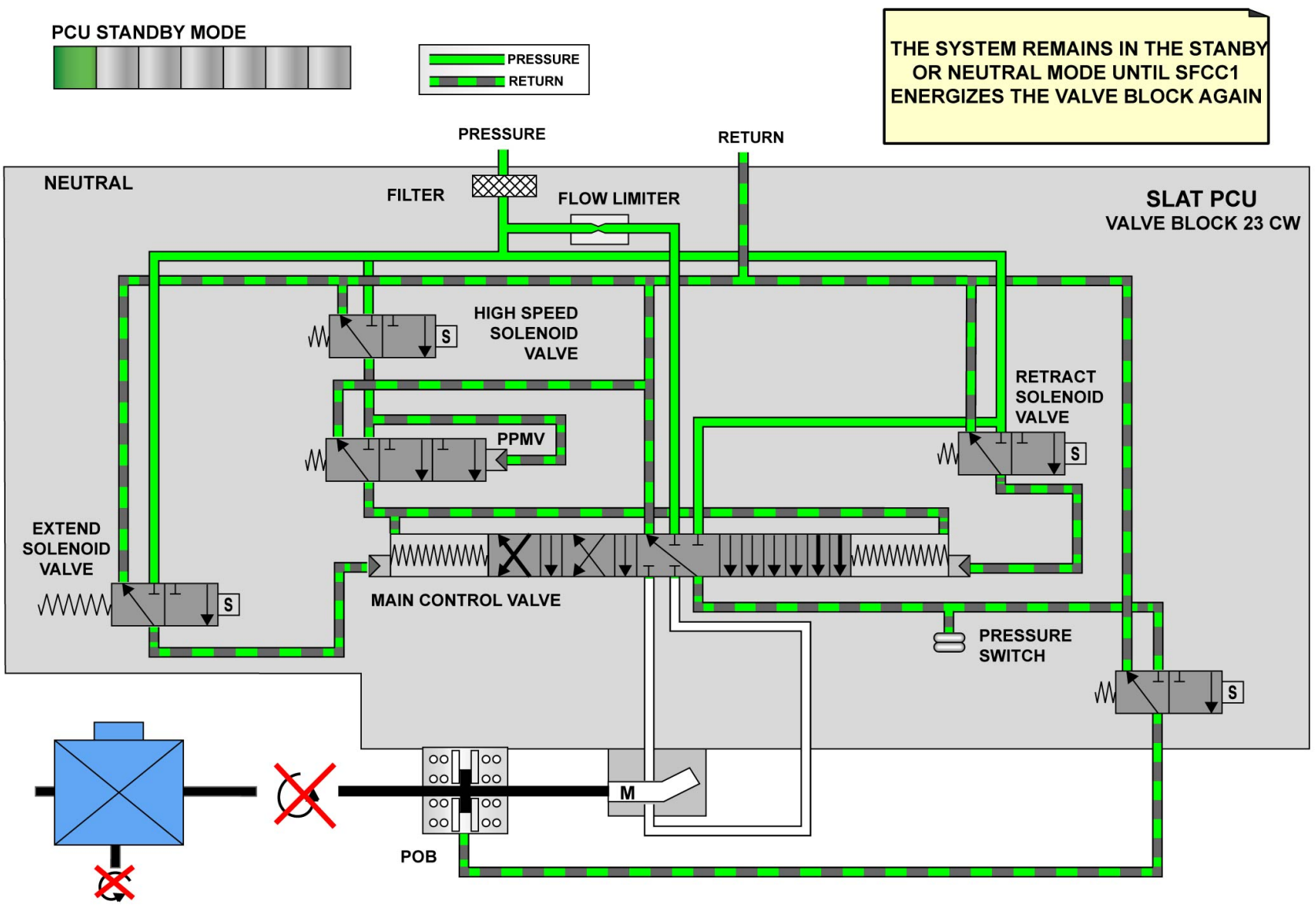

VALVE BLOCK OPERATION

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

WING TIP BRAKE (WTB) NORMAL OPERATION

During normal system operation WTB are released. In this configuration both solenoids are energized, one by SFCC 1 the other one by SFFC 2. Both corresponding hydraulic circuits are pressurized. The pressure force applied to the dual pistons compresses the spring pack through the pressure plate. The friction plates and the through shaft are free in rotation.

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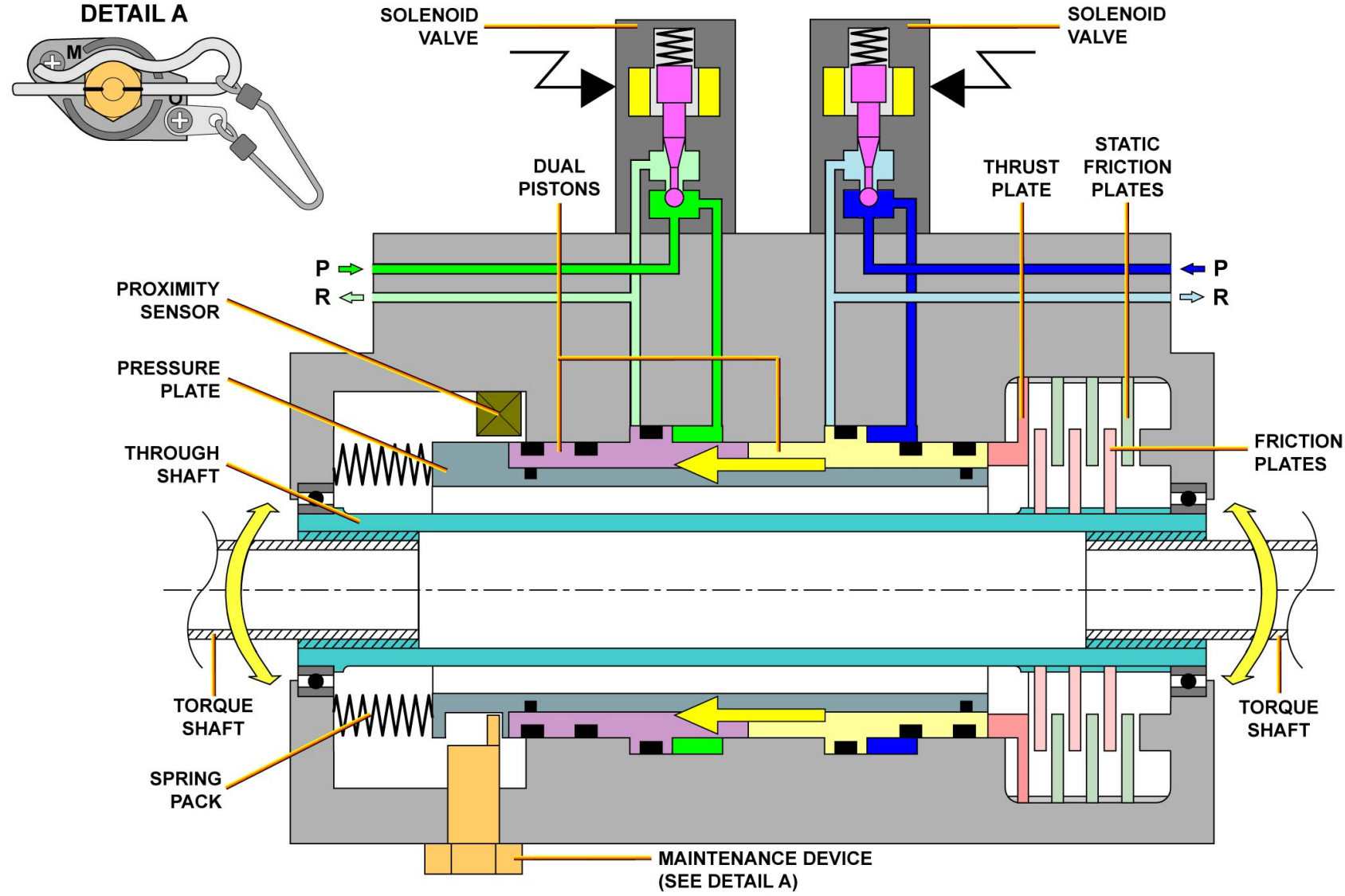

WING TIP BRAKE (WTB) NORMAL OPERATION

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SECONDARY CONTROL SLAT & FLAP NORMAL OPERATION D/O (3)

AUTOMATIC WING TIP BRAKE (WTB) ENGAGEMENT TEST

Engagement test of the WTBs is performed automatically by the SFCCs on a daily basis during flight phase 9 (after landing).
Slat WTBs are tested by the slat channel of SFCC 1 only. Flap WTBs are tested by the flap channel of SFCC 2 only.
During automatic engagement test of a given WTB, solenoids are de-energized by the SFCCs , then actual engagement of the WTB is checked by the SFCC from the proximity sensor feed-back signal.
For a given WTB, engagement test is successful if the SFCC get a "target far" signal from the proximity sensor.
If the test is successful the day counter of the SFCC is set to zero.
If the test is not done (test conditions not met) or unsuccessful for 10 consecutive days, depending on the affected system, warning "FLAP TIP BRAKE FAULT" or "SLAT TIP BRAKE FAULT" is displayed on ECAM associated to the maintenance message "PERFORM WTB ENGAGEMENT TEST".
In this case the WTB engagement test has to be done manually by maintenance personnel through the MCDU.

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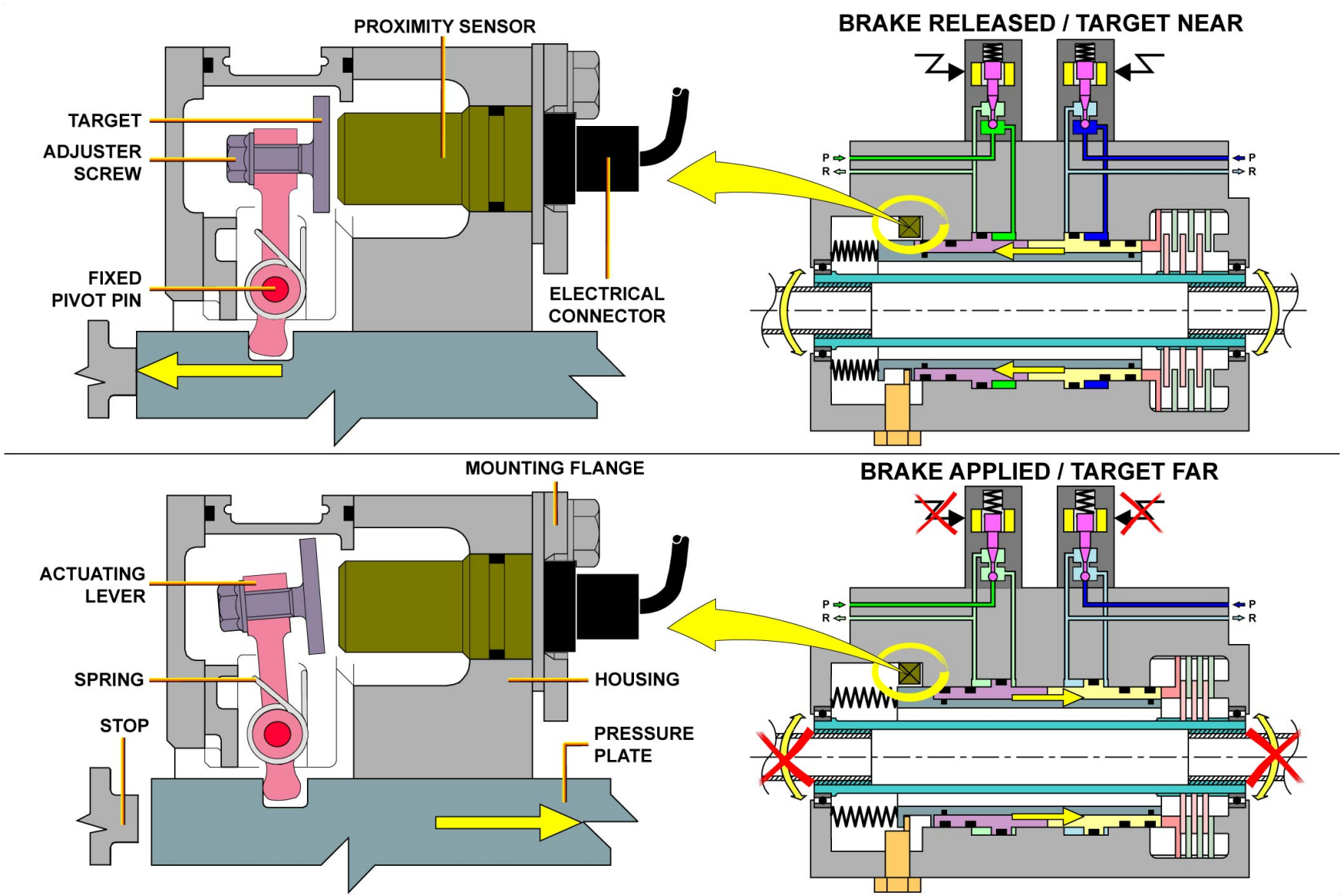

AUTOMATIC WING TIP BRAKE (WTB) ENGAGEMENT TEST

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SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

HALF SPEED OPERATION (ELECTRICAL FAILURE)

When an SFCC detects some failure(s) on its related channel, an abnormal valve block shutdown occurs:
- the electrical power is removed from the related PCU solenoid valves,
- the POBs are applied and stop their related hydraulic motors,

Operation is possible with the other valve block, but only with half speed.
A message is shown on the SD STATUS page.

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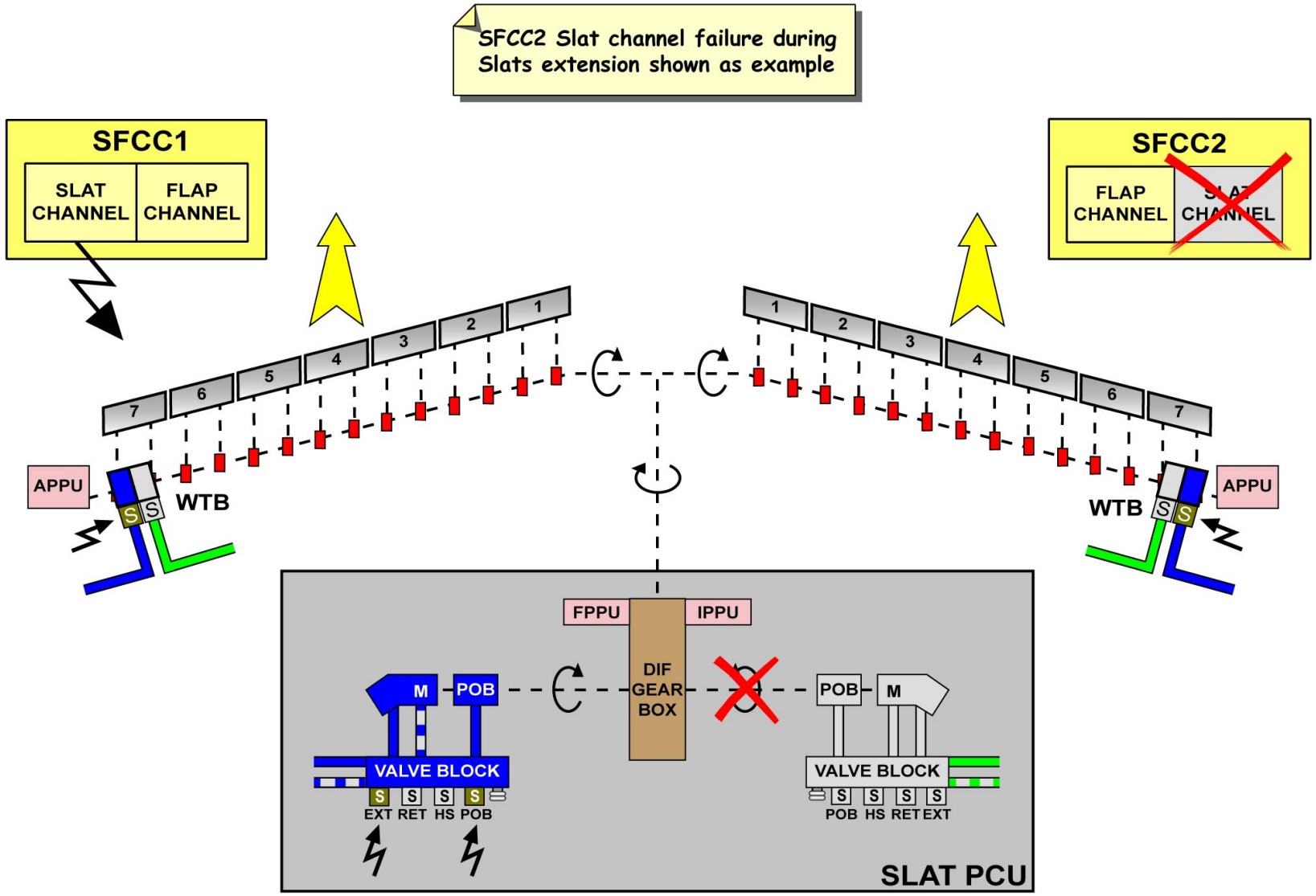

HALF SPEED OPERATION (ELECTRICAL FAILURE)

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SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

HALF SPEED OPERATION (HYDRAULIC FAILURE)

When one of the hydraulic supplies is missing, the following occurs:
- the electrical power is removed by the SFCC from their related PCU solenoid valves.
- POBs mounted on PCUs are applied and stop their related hydraulic motors.

Due to the presence of the differential gearbox, operation is possible with the other valve block, but only with half speed. A message is shown on the SD STATUS page.
If both hydraulic supplies are missing, the transmission system is stopped.

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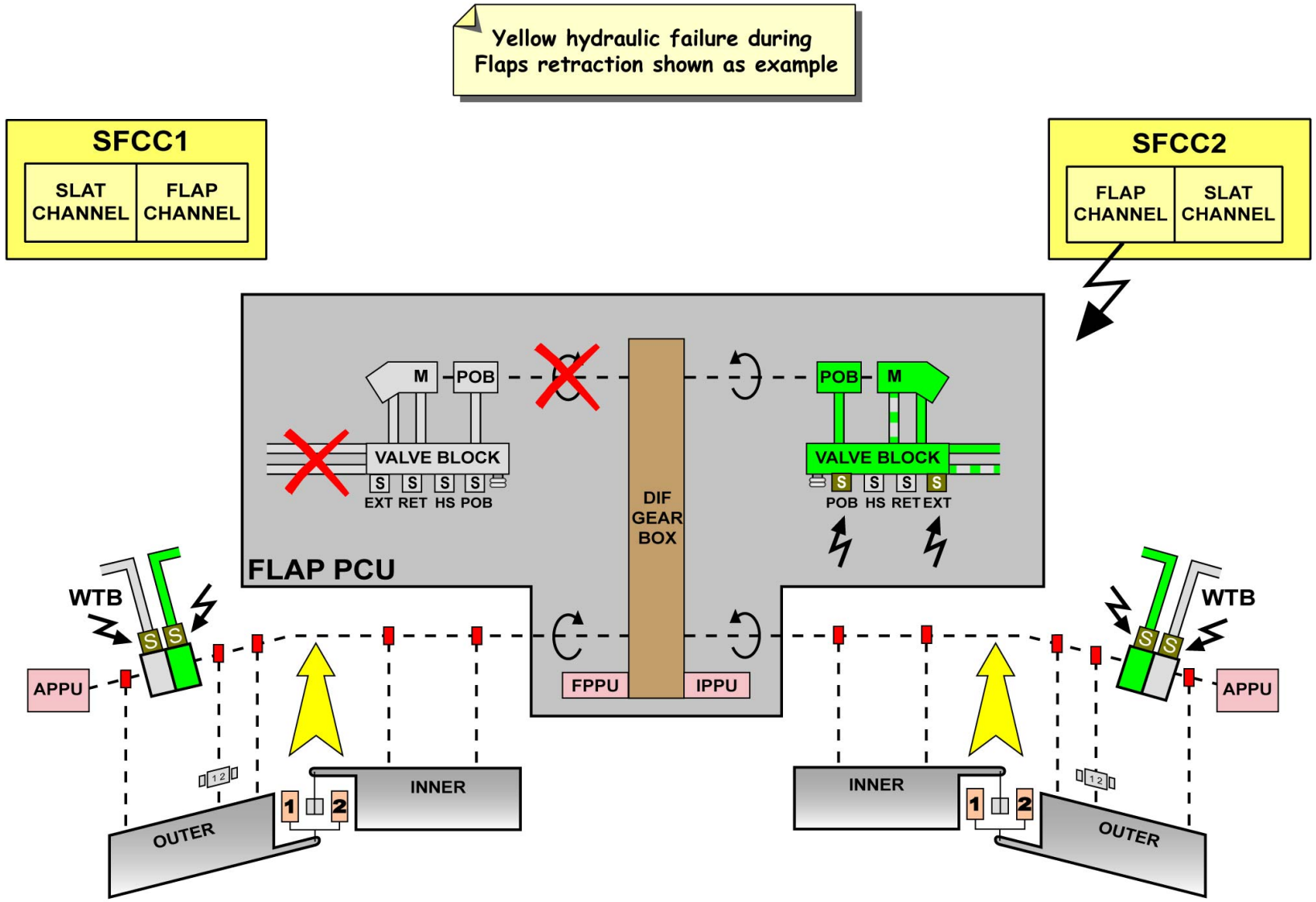

HALF SPEED OPERATION (HYDRAULIC FAILURE)

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SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

SYSTEM JAM

If the combined operational speed of the two hydraulic motors falls below the jam threshold, the SFCCs detect a jam and perform a shutdown of the PCU valve block and stop more start-ups of the PCU valve block.
The SFCCs transmit a warning signal " RECYCLE " to the EIS.
Then if a reverse lever selection is made, the SFCCs receive a new correct CSU command. It cancels the PCU start-up inhibition thus move the surfaces to the opposite direction (reset). Depending on the severity of the jam, reverse selection (reset) is possible or not.
A system jam can be caused by foreign object damage (FOD), ice formation on tracks or a lack of grease, oil, lubricant or semi-fluid in actuators/gearboxes.
If the transmission is mechanically jammed and cannot be reset from the cockpit, maintenance troubleshooting is necessary: First, look at the system torque limiters indicator to know on which side is located the problem. A red pop-out indicator protrudes on the jammed side. Then, move from each actuator torque limiter indicator to the other. If an indicator is popped out, the problem is located around its vicinity. Several locations may be affected.

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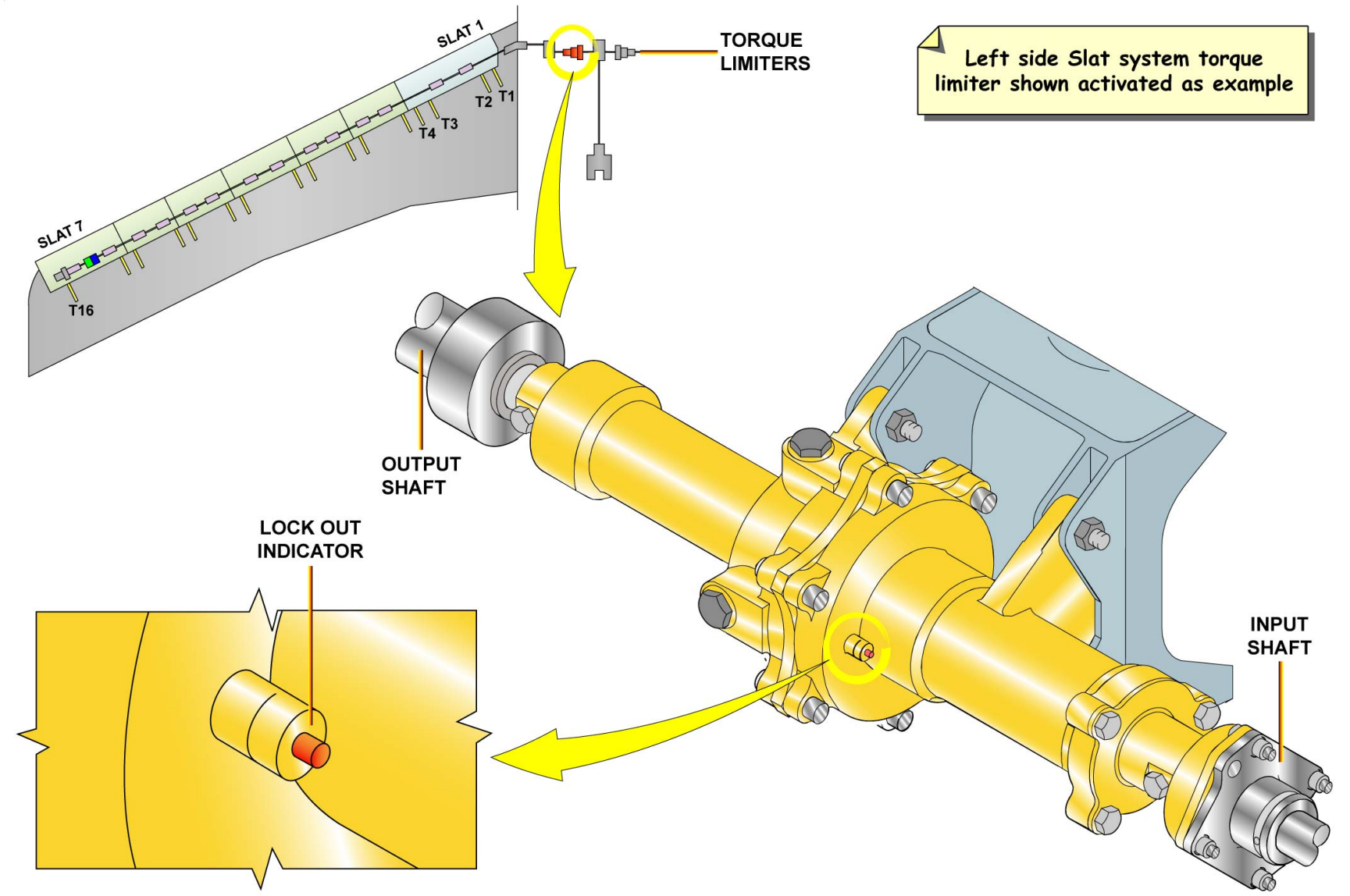

SYSTEM JAM

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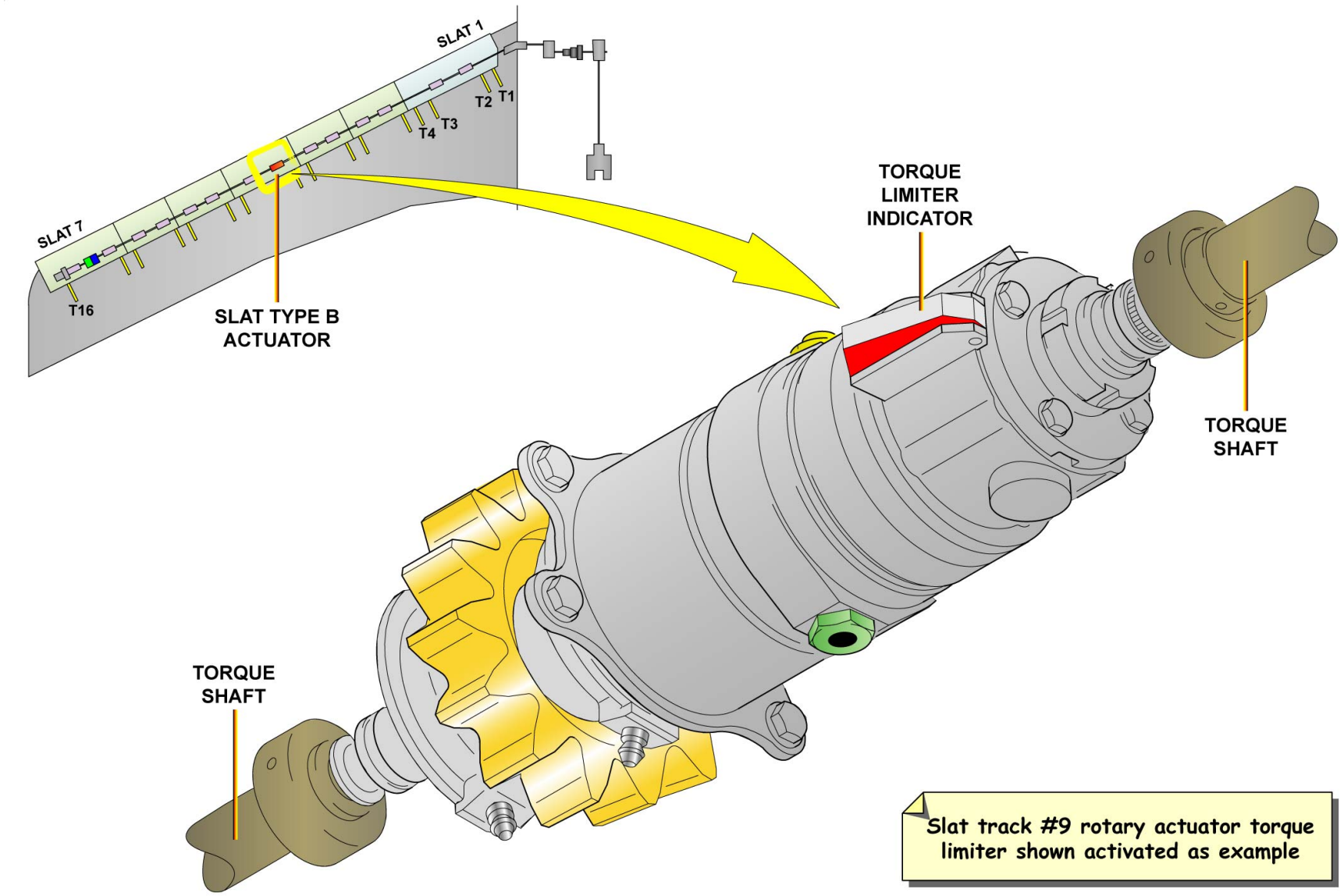

SYSTEM JAM

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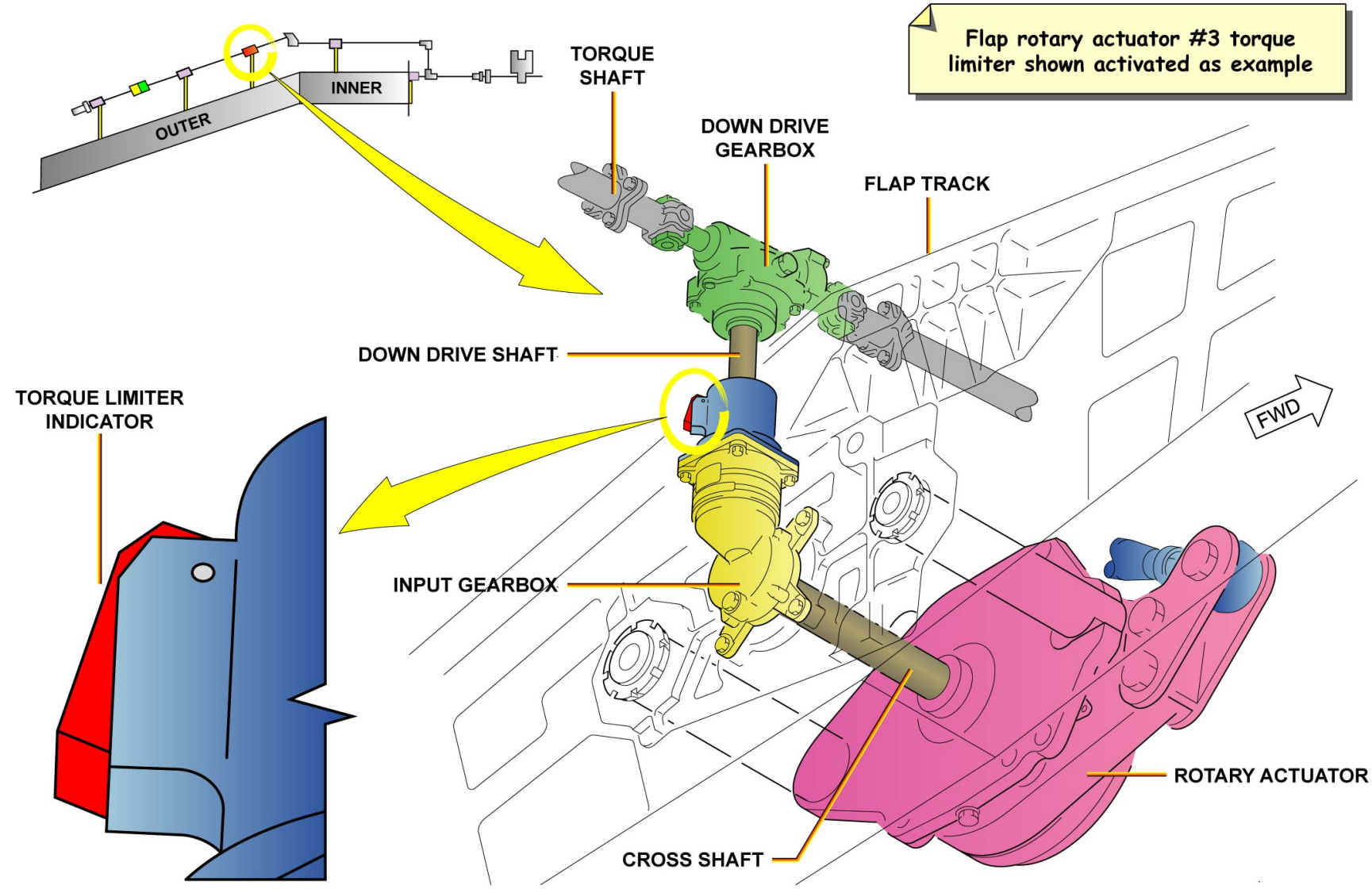
Flap rotary actuator #3 torque limiter shown activated as example
OUTER
INNER
TORQUE SHAFT
DOWN DRIVE GEARBOX
FLAP TRACK
DOWN DRIVE SHAFT
TORQUE LIMITER INDICATOR
FWD
INPUT GEARBOX
ROTARY ACTUATOR
CROSS SHAFT

SYSTEM JAM

SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

FLAP ATTACHMENT FAILURE (INTERCONNECTING STRUT)

The SFCCs monitor the disconnect switches in the flap interconnecting struts for a flap disconnect at the drive station 1, 2 or 3. If a SFCC detects a flap disconnect it performs an abnormal shutdown of the related PCU valve block, stops more start-ups of the related valve block (reset only on ground or SFCC power-up) and transmits a failure message to the second SFCC.
If the second SFCC confirms the failure it confirms the valve block start-up inhibition. The SFCCs transmit a warning signal to the EIS.

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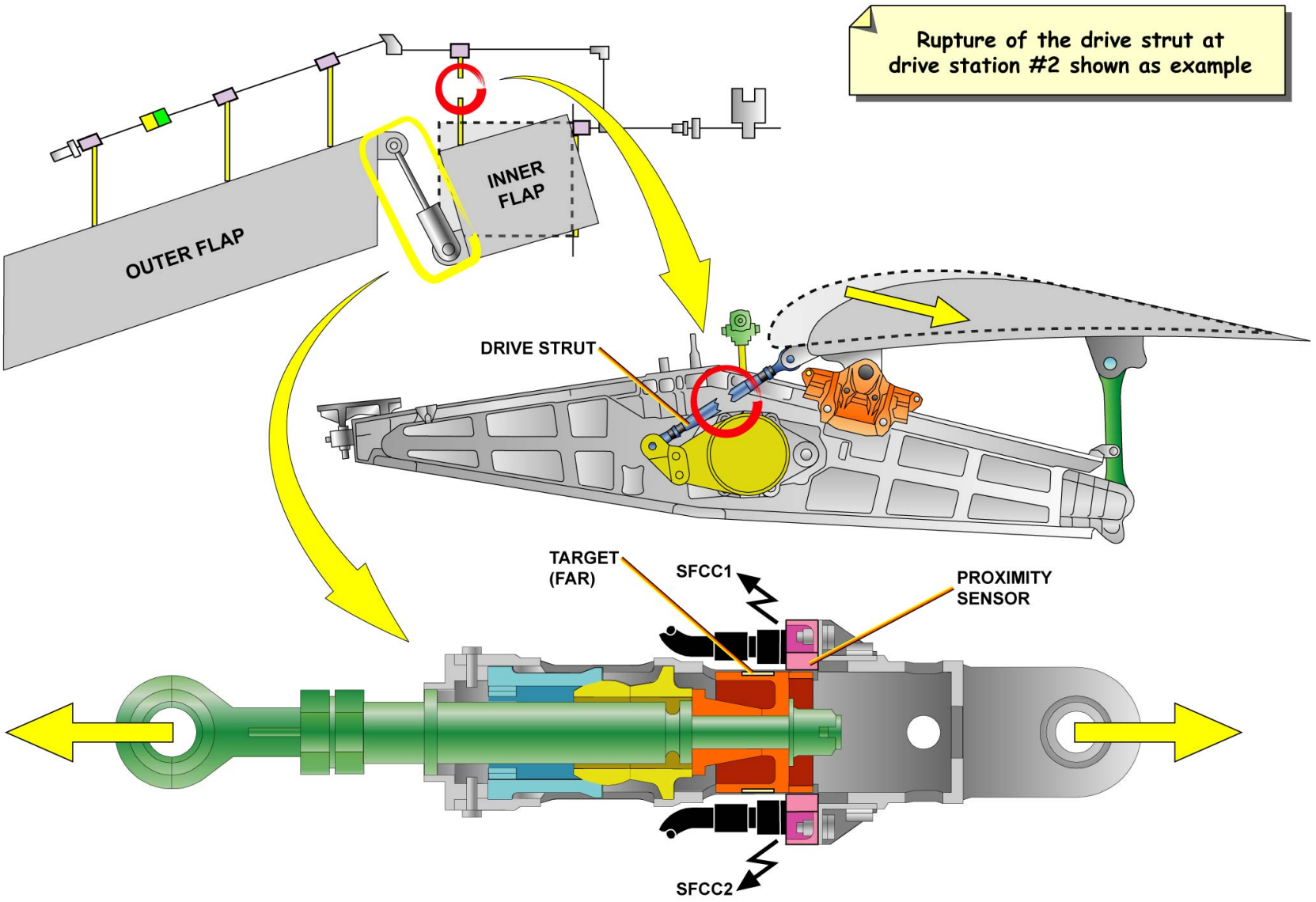

FLAP ATTACHMENT FAILURE (INTERCONNECTING STRUT)

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SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

FLAP ATTACHMENT FAILURE (TRACK 4 SENSOR STRUT)

The same occurs if a Flap Track 4 sensor detects a flap disconnect.

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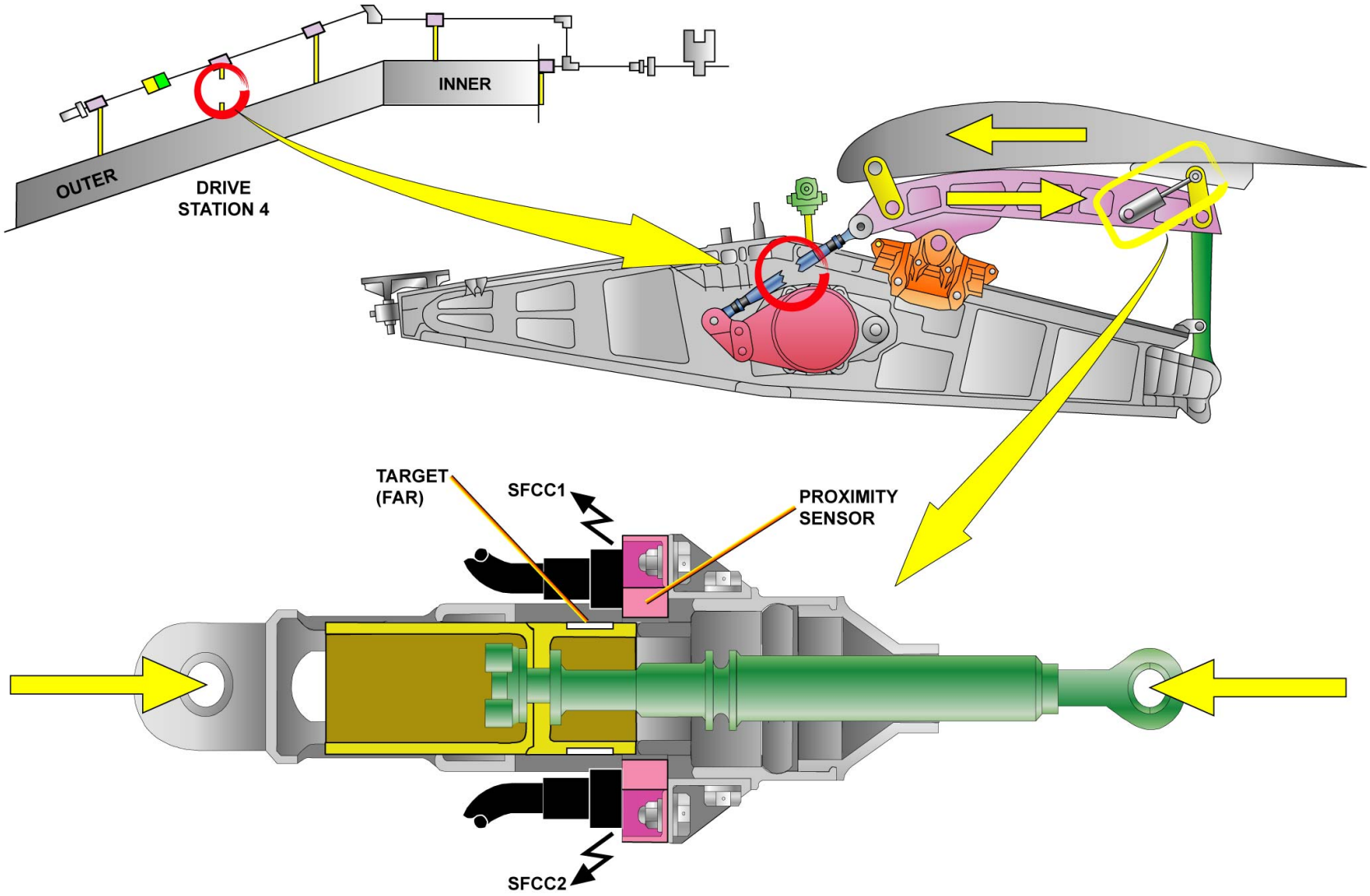

FLAP ATTACHMENT FAILURE (TRACK 4 SENSOR STRUT)

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SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

FAILURE

An electro hydraulic pressure-off brake (referred to as a WTB) is located near the end of the slat and flap transmission systems in each wing. The WTBs stop and hold the transmission if the SFCC detects some given types of failures such as asymmetry, runaway, over speed or uncommanded movement. Each WTB has two solenoid valves. The WTB solenoid valves receive power through their related SFCCs.
When WTBs are applied, no further movement of the affected system is possible; reset is only possible on the ground via the MCDU by the SFCC/WTB RESET menu page.

ASYMMETRY

An asymmetry is a position difference between the left and right APPUs of the transmission system (i.e: broken left torque tube) . A failure is given as valid if the recorded value is outside the limit.
If an SFCC detects an asymmetry it:
- de-energizes its related WTB circuits,
- performs an abnormal shutdown of the related PCU valve block,
- stops more start-ups of its related PCU valve block,
- transmit a warning signal to the EIS.
- transmits a failure message to the other SFCC flap channel.

If the flap channel of the other SFCC confirms the failure it:
- software latches the WTBs,
- confirms the valve-block start-up inhibition,

If the second SFCC does not confirm the failure the system gives a PPU failure message and holds the failure message in the nonvolatile memory.
If an unconfirmed asymmetry disappears from the first flap channel, and the flight crew select a new CSU position, the SFCC:
- energizes the WTB solenoids,
- cancels the PCU valve-block start-up inhibition,
- cancels the warning signal to the EIS,
- cancels the second SFCC flap-channel failure message.

RUNAWAY

A runaway is given as a positional difference between both APPUs and the FPPU (i.e: broken output shaft) The SFCCs monitor the system for runaway. If a SFCC detects a runaway it does the same actions as an asymmetry.

UNCOMMANDED MOVEMENT

If the system moves from its last commanded position or in the wrong direction, the SFCCs calculates the direction in which the system moves with data from the Air Data/Inertial Reference Unit (ADIRU) and the CSU.
If a SFCC finds an uncommanded movement it does the same actions as an asymmetry.

OVERSPEED

An overspeed is given when the speed of the flap torque shafts, measured at the APPU, is too high (ie: high speed solenoid failure).
If a SFCC detects a valid overspeed it does the same actions as an asymmetry.

WTB MANUAL RELEASE

The SFCCs monitor the WTB proximity switches and the hydraulic system pressure. It finds a WTB manual release condition when the maintenance device of the WTB is in the "M" position, the hydraulic system pressure switch finds a low system pressure and the WTB proximity switch indicates target FAR.
If the SFCCs find a manual release, it:
- de-energizes and hardware latches the WTBs,
- performs an abnormal shutdown of the related PCU valve block,
- stops more start-ups of the related PCU valve block,
- transmits a warning signal to the EIS (SLAT/FLAP TIP BRK FAULT), transmits a failure message to the second SFCC,

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- keeps the failure data in the nonvolatile memory.

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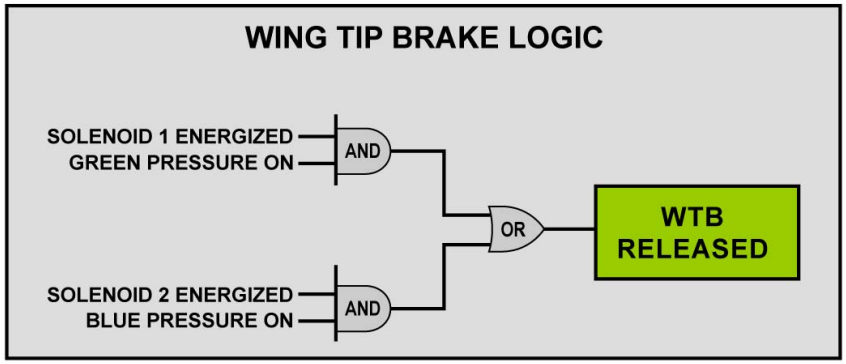

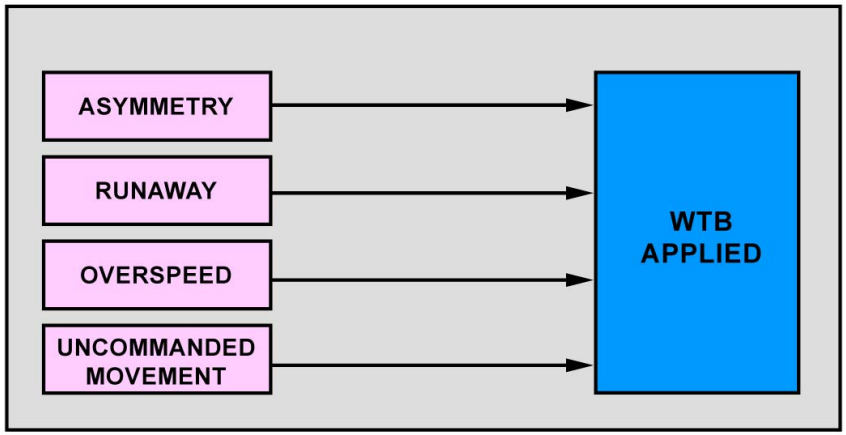

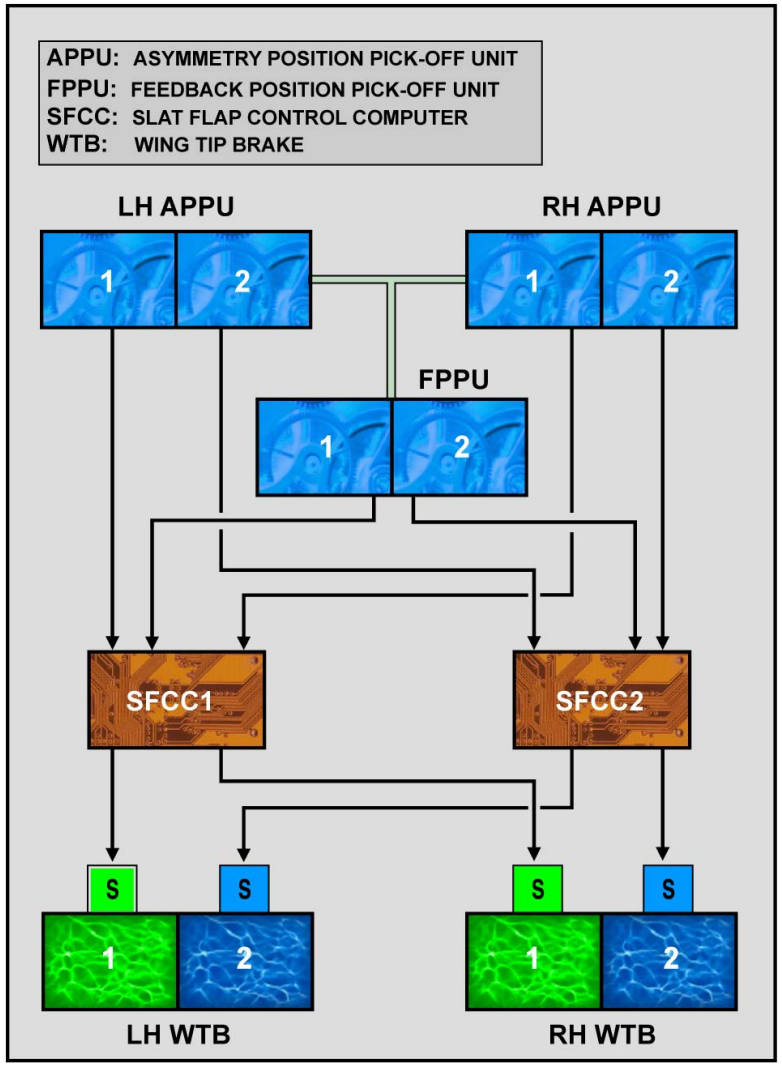

FAILURE - ASYMMETRY ... WTB MANUAL RELEASE

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G9409341 - GAUT0T0 - FM27D8000000002

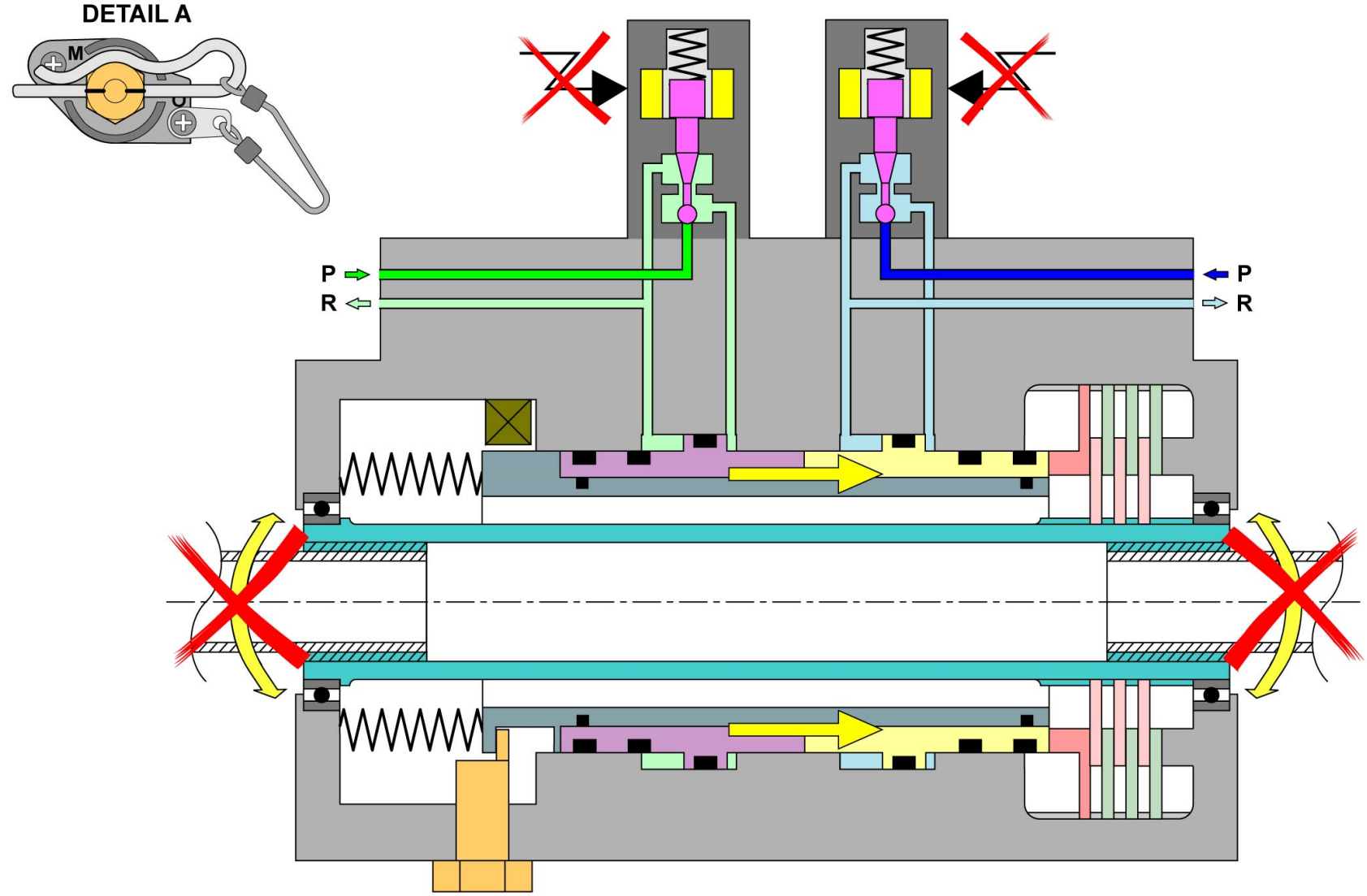
SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

WING TIP BRAKE (WTB) OPERATION

SOLENOIDS DE-ENERGIZED

In case of an asymmetry, runaway, over speed or uncommanded movement being detected by SFCC 1 and SFCC 2 on the slat or flap systems, both LH and RH Wing Tip Brakes of the affected system are applied: on each WTB the two solenoids are de-energized by the SFCCs.

G9409341 - GAUT0T0 - FM27D8000000002



WING TIP BRAKE (WTB) OPERATION - SOLENOIDS DE-ENERGIZED

G9409341 - GAUT0T0 - FM27D8000000002

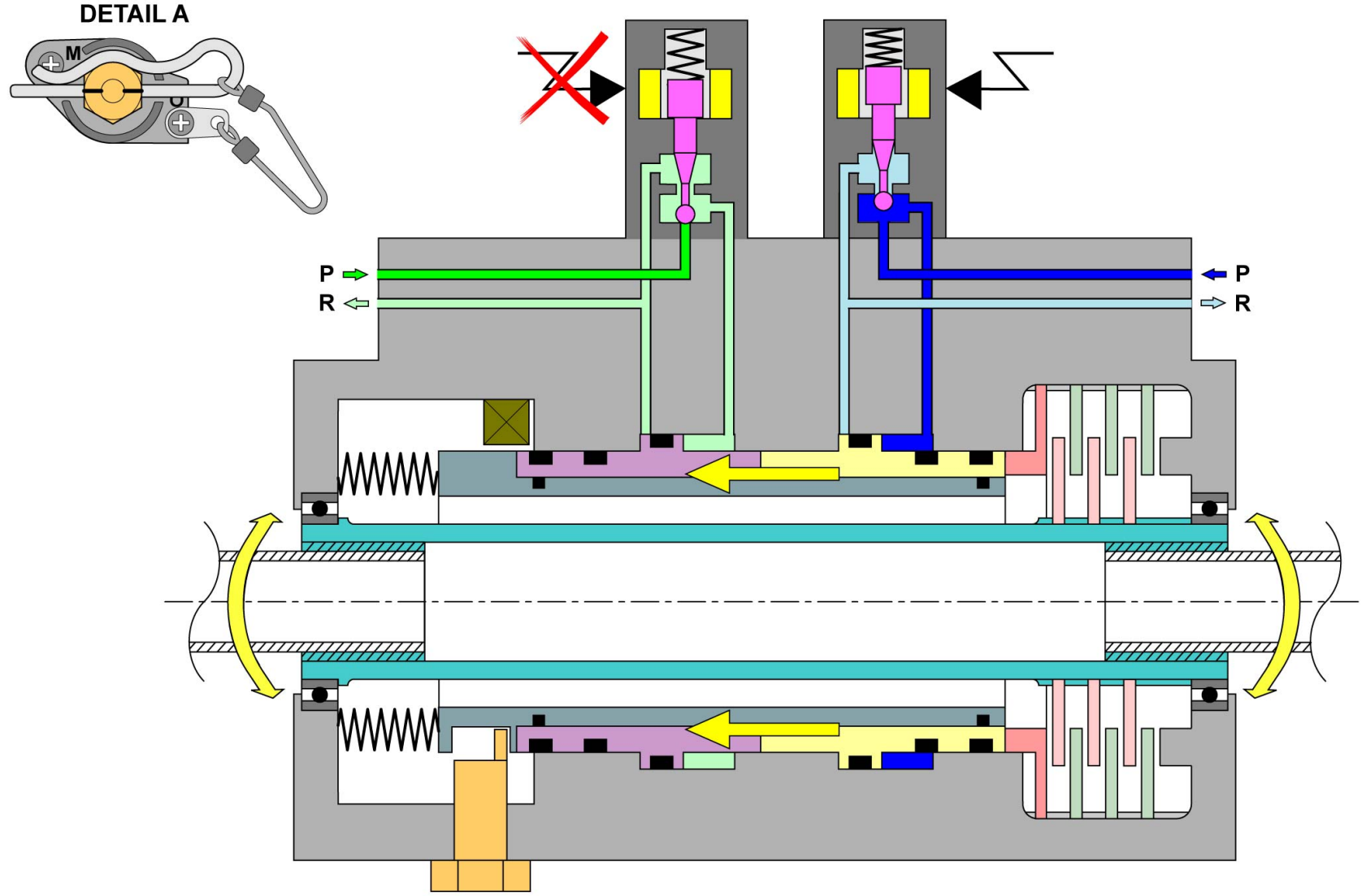
SECONDARY CONTROL SLAT & FLAP ABNORMAL OPERATION D/O (3)

WING TIP BRAKE (WTB) OPERATION (continued)

ONLY ONE SOLENOID ENERGIZED

In case of an asymmetry, runaway, over speed or uncommanded movement being detected by only one SFCC, only the corresponding solenoid is de-energized; the other one remains energized by the SFCC having not detected the fault. In this configuration the WTB remains released.

G9409341 - GAUT0T0 - FM27D8000000002



WING TIP BRAKE (WTB) OPERATION - ONLY ONE SOLENOID ENERGIZED

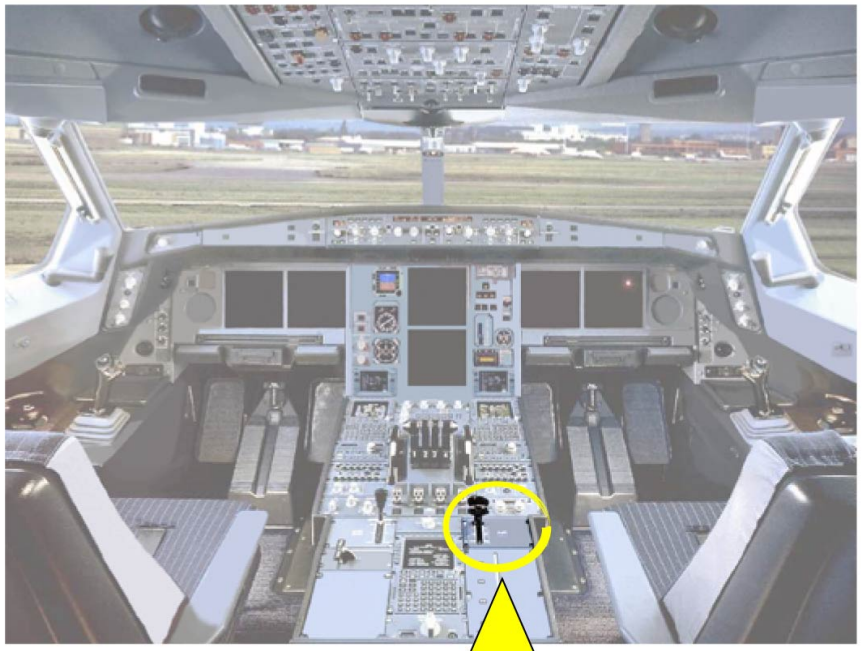
G9409341 - GAUT0T0 - FM27D8000000002

SECONDARY CONTROL LAWS D/O (3)

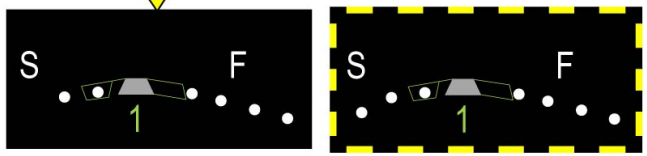
SLAT FLAP CONTROL LEVER

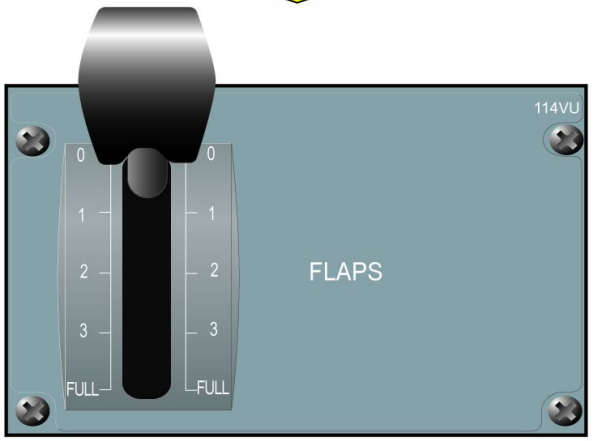
The slat flap position indication is displayed on the ECAM EWD.
The slat flap control lever is installed in the cockpit on the center pedestal panel 114VU, and is connected to the Command Sensor Unit (CSU) which transforms the mechanical demand into electrical signals to the Slat Flap Control Computers (SFCCs).
The lever selects simultaneous operation of the slats and flaps and must be pulled out of the detent before selection of any position. The relationship between the lever position, flight phase and slat flap angles is shown in the following table.

G9409341 - GAUT0T0 - FM27D9F27CE0203



ECAM 742VU





A330 ONLY

LEVER POSITION	FLIGHT PHASE	SLAT ANGLE		FLAP ANGLE	
		A330	A340	A330	A340
0	CRUISE	0°	0°	0°	0°
1	HOLD	17°	21°	0°	0°
1+F	TAKE-OFF	17°	21°	8.5°	17.5°
2	TAKE-OFF 1	21°	24°	14.5°	22.5°
3	TAKE-OFF 2 APPROACH	24°	24°	22.5°	26.5°
FULL	LAND	24°	24°	32°	32°

SLAT FLAP CONTROL LEVER

G9409341 - GAUT0T0 - FM27D9F27CE0203

SECONDARY CONTROL LAWS D/O (3)

EXTENSION ON GROUND

First slats and flaps are fully retracted and the clean configuration is displayed on the ECAM. On ground, when position 1 is selected, both slats and flaps extend. The take-off configuration is 1+F. Then 2 and 3 will be selected, and consecutively the FULL position.
In the FULL position slats and flaps are fully extended.

RETRACTION ON GROUND

The retraction sequence is the same as the extension sequence in inverse order.
With the A/C on ground and before both slats and flaps begin to retract, the configuration is 1+F.
Once the surfaces have reached the fully retracted position, the clean configuration is displayed on the ECAM.

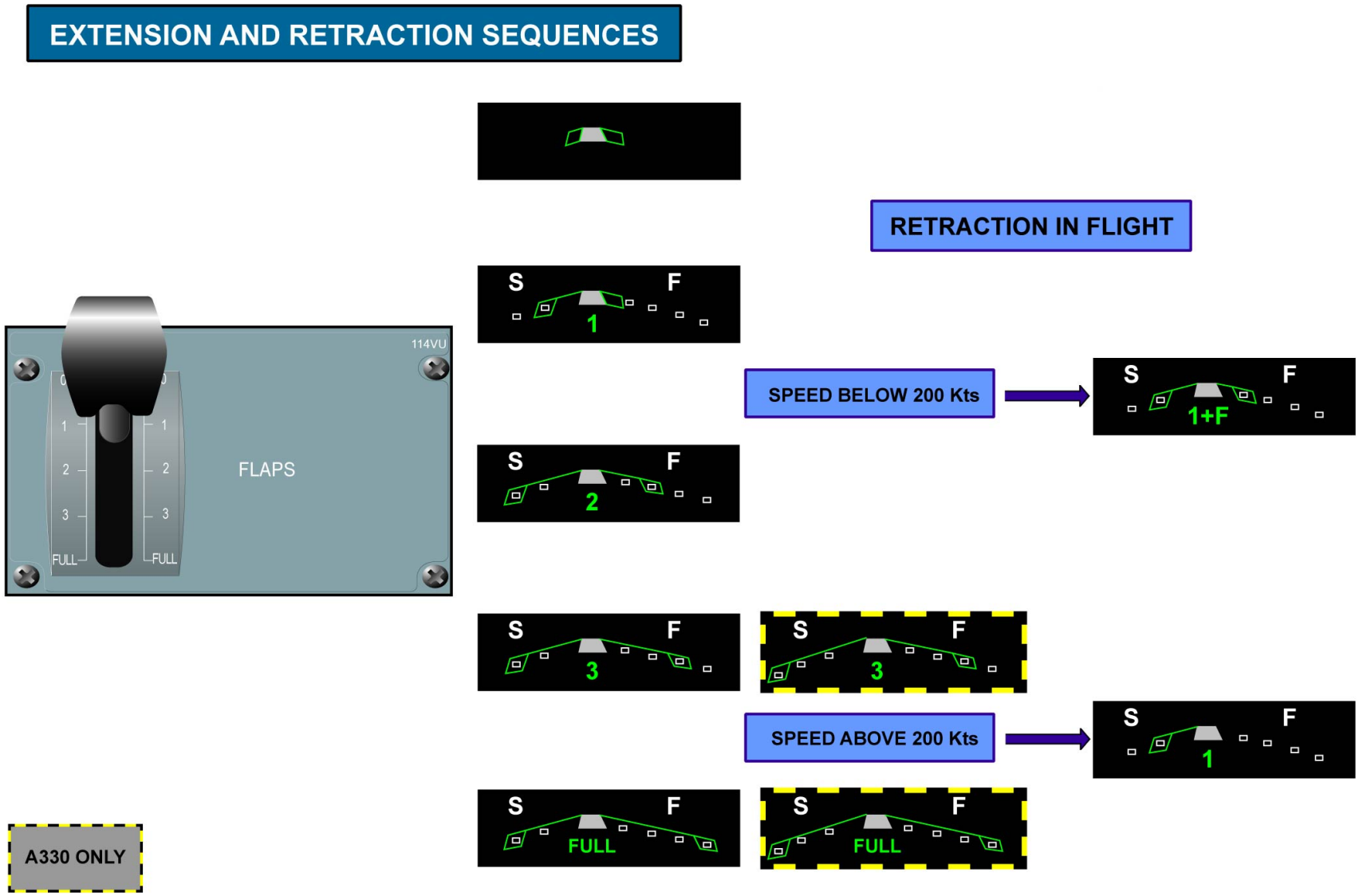
EXTENSION IN FLIGHT

First slats and flaps are fully retracted and the clean configuration is displayed on the ECAM. In flight, when position 1 is selected, only slats extend. For positions 2, 3 and FULL, the deflection angles are the same as those for extension on ground.

RETRACTION IN FLIGHT

Retraction, from fully extended to position 3 and from position 3 to position 2, is identical to surface retraction on ground.
There are two flap configurations, depending on the Computed Air Speeds (CAS), for retraction to position 1 in flight:
- when the speed is below 200 Kts,
- when the speed is above 200 Kts.

G9409341 - GAUT0T0 - FM27D9F27CE0203



EXTENSION ON GROUND ... RETRACTION IN FLIGHT

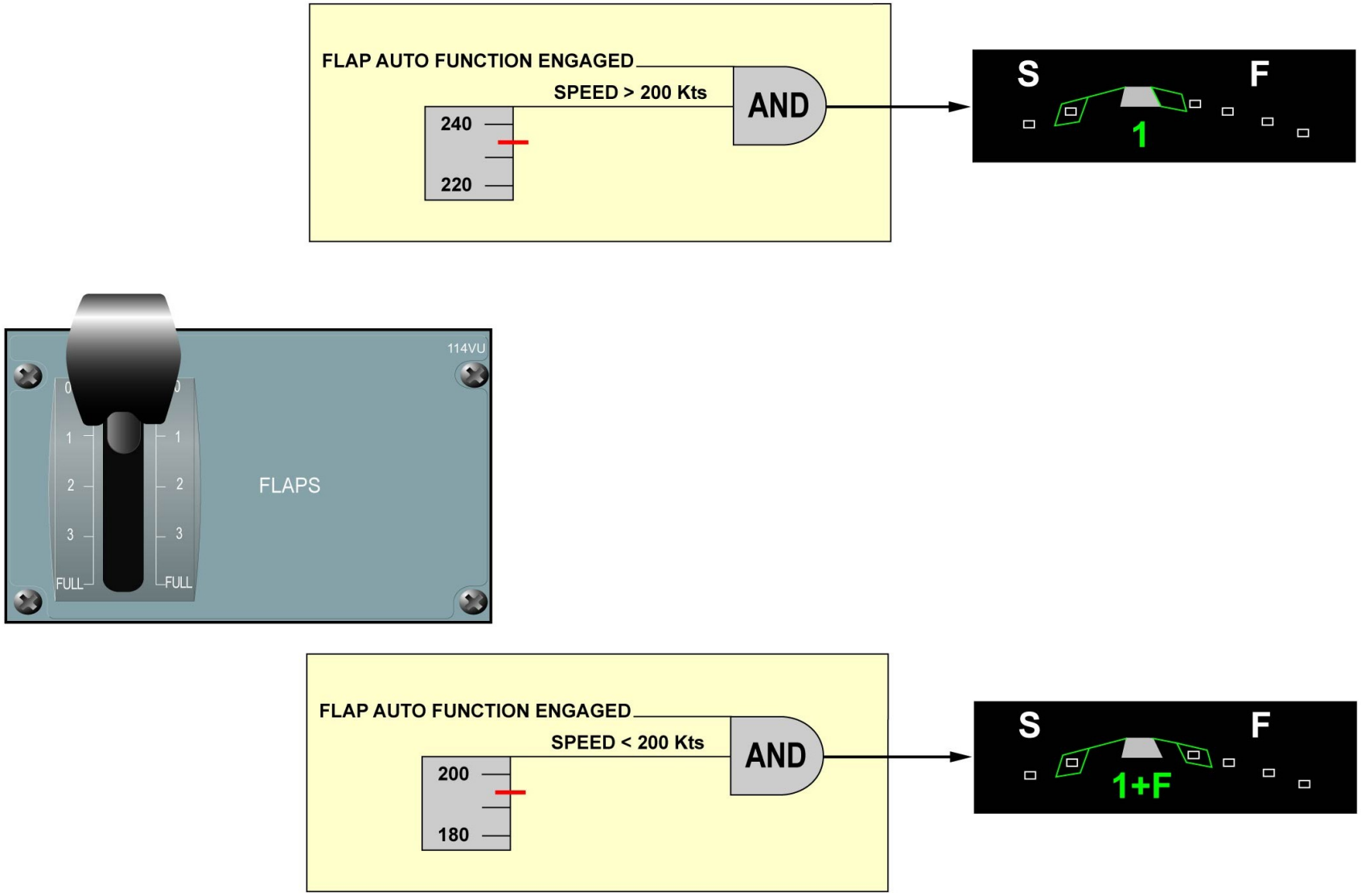
SECONDARY CONTROL LAWS D/O (3)

AUTOMATIC RETRACTION IN FLIGHT

The current speed must be lower than 200 Kts, the configuration 1+F and the flap auto function are engaged.
When the CAS reaches 200 Kts, the flaps retract automatically to 0 and the new slat flap configuration is 1.

NOTE: Note that, when take-off is done in configuration 1+F, flaps fully retract automatically at 200 Kts if configuration 0 is not selected after take-off.

After an automatic flap retraction, there is no automatic re-extension if the speed drops below 200 Kts.



AUTOMATIC RETRACTION IN FLIGHT

G9409341 - GAUT0T0 - FM27D9F27CE0203

SECONDARY CONTROL LAWS D/O (3)

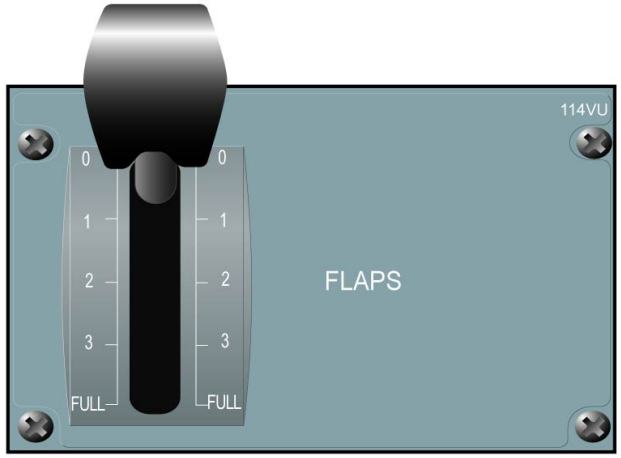
FLAP RELIEF

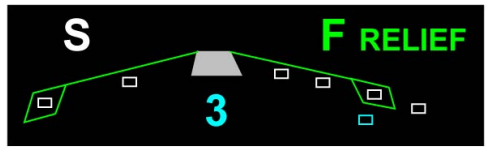
The flap relief and slat alpha lock functions will be shown in these last two topics.
The relief function limits flap surface extension to a relief angle as airspeed increases and exceeds Velocity Flap Extended (VFE).
When activated, the flap load relief system retracts the flaps to the deflection corresponding to the lever position just below the present one. In that case, a green pulse F RELIEF message is displayed on the ECAM.
When the airspeed drops below VFE, the flaps automatically extend again to a larger angle.

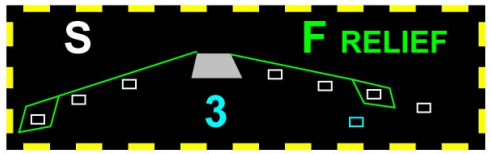
SLAT ALPHA LOCK

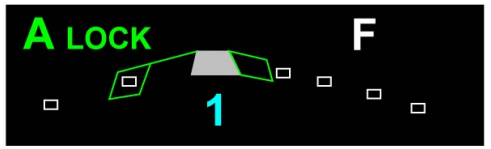
The slat channels of the SFCCs receive Corrected Angle Of Attack (CAOA) and CAS provided by the Air Data Inertial Reference Units (ADIRUs) for the use of alpha lock computation.
When the angle of attack is high (alpha lock) or the speed is too low (slat baulk) slat retraction from position 1 to 0 is inhibited to prevent the A/C from stalling. A green pulse A LOCK message is displayed to indicate the retraction inhibition.
Slat retraction from position 1 to 0 is prevented if CAOA > 8.5º or CAS < 148 kts. The alpha lock function is reset if CAOA < 7.6 º or CAS > 154 Kts.
The function is not active if:
- the A/C is on ground with CAS < 60 Kts,
- alpha exceeds 8.5º or CAS drops below 148 Kts while retraction from position 1 to 0 has already started.

G9409341 - GAUT0T0 - FM27D9F27CE0203









A330 ONLY

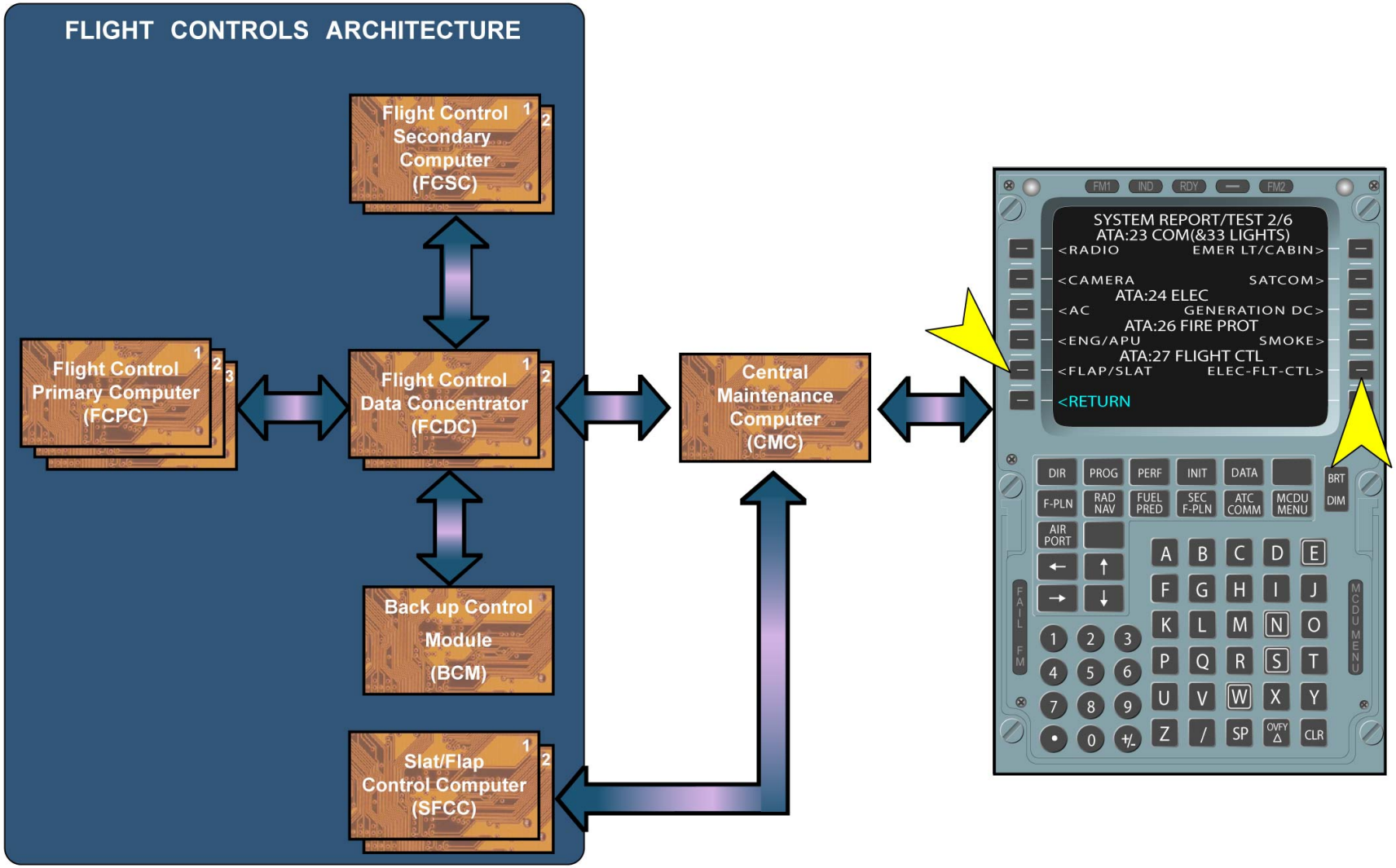
FLAP RELIEF & SLAT ALPHA LOCK

FLIGHT CONTROLS MCDU PAGES (2)

GENERAL

The flight controls architecture is built around the following computers:
- 3 Flight Control Primary Computers (FCPCs),
- 2 Flight Control Secondary Computers (FCSCs),
- 2 Flight Control Data Concentrators (FCDCs),
- 2 Slat/Flap Control Computers (SFCCs).
- 1 Back up Control Module (BCM).

The FCPCs, FCSCs and BCM send failure information to the FCDCs which analyze, store and send maintenance messages to the Central Maintenance Computer (CMC). This is the Electrical Flight Control System (EFCS) part (primary flight controls).
For the high lift part, the SFCCs send failure data directly to the CMC.
Maintenance message interrogation is done using the MCDU. The SYSTEM REPORT/TEST function of the Central Maintenance System (CMS) ground menu gives access to an interactive mode which allows the retrieval of flight control system troubleshooting data and can initiate EFCS and SFCC system tests.



GENERAL

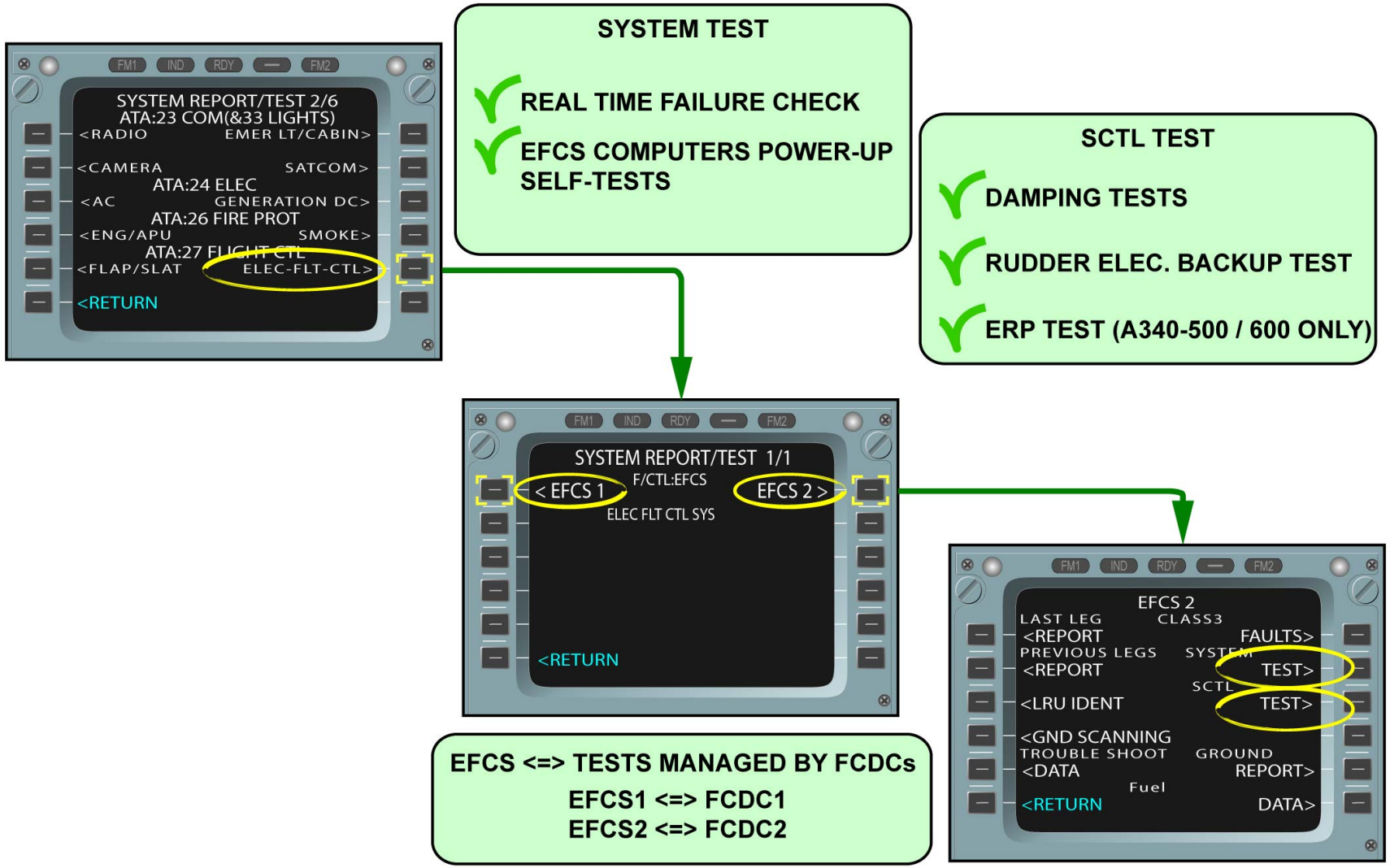
G9409341 - GAUT0T0 - FM27P4MCDUTST02

FLIGHT CONTROLS MCDU PAGES (2)

ELECTRONIC FLIGHT CONTROL SYSTEM

From the main menu of the SYSTEM REPORT/TEST page, it is possible to select the ELEC-FLT-CTL system menu. EFCS 1 and 2 permit access to the system tests managed by the FCDCs. EFCS 1 main menu is linked to FCDC 1, EFCS 2 to FCDC 2.
Both EFCS menus give access to a classic type 1 computer menu with GND SCANNING capability and specific functions as follows.
The SYSTEM TEST checks failures affecting the EFCS present at the time of request. This test forces the FCPCs, FCSCs and the opposite FCDC to run their power-up self-tests.
The SCTL TEST menu accesses the damping tests for the elevator, aileron and rudder servo controls.
The SCTL TEST menu also permits a test of the rudder electrical backup with the BCM.

NOTE: On the A340-500/600 only, the two Enhanced Runaway Protection (ERP) devices fitted on the THS actuator can also be tested through the SCTL TEST menu.



ELECTRONIC FLIGHT CONTROL SYSTEM

G9409341 - GAUT0T0 - FM27P4MCDUTST02

FLIGHT CONTROLS MCDU PAGES (2)

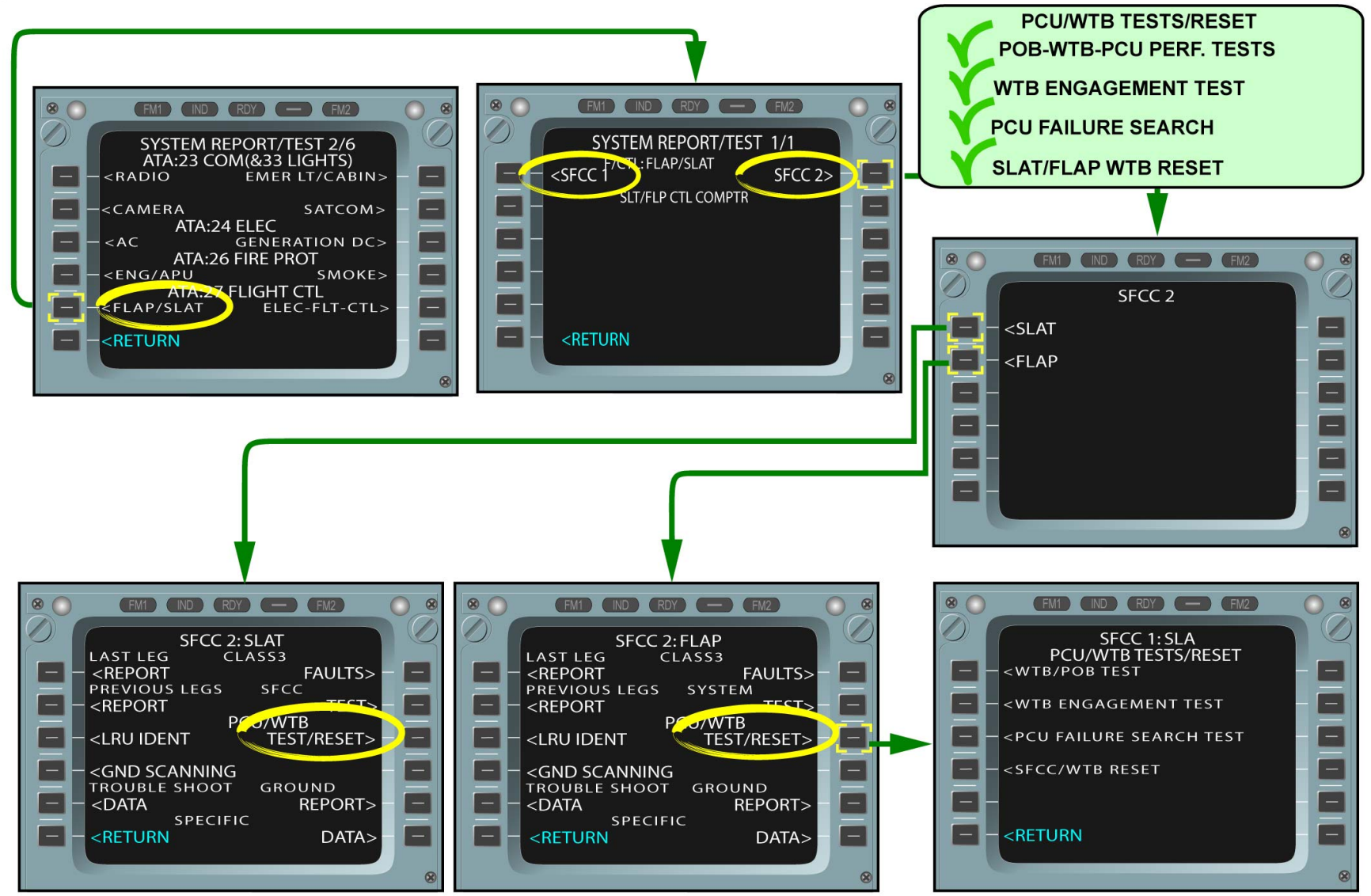
SLAT FLAP CONTROL COMPUTER

From the main menu of the SYSTEM REPORT/TEST page, it is possible to select the FLAP/SLAP system menu.
Tests can be performed from SFCC 1 or 2. Each computer permits access to two dedicated menus. One for the SLAT system and one for the FLAP system.
The SLAT menu gives access to a classic type 1 computer menu with GND SCANNING capability and specific functions.
The SFCC TEST menu checks for internal SFCC failures and internal or external system failures.
The PCU/WTB TEST/RESET menu enables you to perform several interactive tests:
- check of the performance of the Pressure Off Brakes (POB) of the Wing Tip Brake (WTB) and the slat Power Control Unit (PCU),
- test of the WTB engagement,
- slat PCU failure search,
- reset of the slat WTBs after a system failure.

The SPECIFIC DATA menu gives data about slat system signals transmitted to the SFCC.
The FLAP menu gives access to a classic type 1 computer menu with GND SCANNING capability and specific functions.
The SYSTEM TEST menu checks for internal SFCC failures and internal or external system failures.
The PCU/WTB TEST/RESET menu enables you to perform several interactive tests:
- check of the performance of the POB of the WTB and the flap PCU,
- test of the WTB engagement,
- flap PCU failure search,
- reset of the flap WTBs after a system failure.

The SPECIFIC DATA menu gives data about flap system signals transmitted to the SFCC.

G9409341 - GAUT0T0 - FM27P4MCDUTST02



SLAT FLAP CONTROL COMPUTER

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FLIGHT CONTROLS SYSTEM BASE MAINTENANCE (3)

INTRODUCTION

To highlight the adjustment principle applicable to the "fly by wire" flight controls, three maintenance tasks have been chosen:
- adjustment of the ailerons,
- adjustment of the rudder,
- adjustment of the elevators.

WARNING: MAKE SURE THAT THE SAFETY DEVICES AND THE WARNING NOTICES ARE IN POSITION BEFORE YOU START A TASK ON OR NEAR:
- THE FLIGHT CONTROLS,
- THE FLIGHT CONTROL SURFACES,
- THE LANDING GEAR AND THE RELATED DOORS,
- COMPONENTS THAT MOVE.

MOVEMENT OF COMPONENTS CAN KILL OR INJURE PERSONS.
MAKE SURE THAT THE TRAVEL RANGES OF THE FLIGHT CONTROLS ARE CLEAR. MOVEMENT OF FLIGHT CONTROLS CAN CAUSE INJURY TO PERSONS AND/OR DAMAGE.

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

WARNING

WARNING: MAKE SURE THAT THE SAFETY DEVICES AND THE WARNING NOTICES ARE IN POSITION BEFORE YOU START A TASK ON OR NEAR:
- THE FLIGHT CONTROLS,
- THE FLIGHT CONTROL SURFACES,
- THE LANDING COMPONENTS THAT MOVE.
MOVEMENT OF COMPONENTS CAN KILL OR INJURE PERSONS;

WARNING

WARNING: MAKE SURE THAT THE TRAVEL RANGES OF THE FLIGHT CONTROLS ARE CLEAR. MOVEMENT OF FLIGHT CONTROLS CAN CAUSE INJURY TO PERSONS AND/OR DAMAGE.

INTRODUCTION

FLIGHT CONTROLS SYSTEM BASE MAINTENANCE (3)

ADJUSTMENT OF THE AILERONS

Each aileron surface is actuated by two identical servocontrols. The inboard and outboard ailerons do not have the same servocontrols. Nevertheless, the adjustment procedure is identical for all aileron surfaces.
The first step consists in pressurizing the green hydraulic circuit. Also make sure that the blue and the yellow hydraulic circuits are depressurized.
On the FLT CTL sections of the overhead panel, make sure that all flight controls computer P/BSWs are pressed in (the OFF and FAULT legends are not illuminated).
Make sure that the flaps and slats are in the fully retracted position.
Install the side stick locking pin on the CAPT and F/O side sticks. Do not forget to put warning notices on the side sticks to tell personnel not to use them.
Gain access to the green servocontrol which is in the active mode. Put a straight edge on the adjacent structure of the aileron and measure the position of the aileron with a graduated scale.
If the position of the aileron is not satisfactory, adjust the green servocontrol as follows:
-remove the screws and the protective plate on A340-500/600, remove the plug from the servocontrol on A330 and A340-300,
-operate the adjustment device of the Linear Variable Differential Transducer (LVDT) unit until the aileron trailing edge is within the tolerances,
-install the protective plate and the screws on A340-500/600, remove the plug from the servocontrol on A330 and A340-300,
-note the position of the aileron trailing edge.
Pressurize the blue or yellow hydraulic system depending on the aileron you are working on. Blue is for the inboard ailerons and yellow for outboard ailerons. Depressurize the green hydraulic system.
Measure the new position of the aileron with the other servocontrol in active mode. If the distance between the two positions is not within the tolerance (refer to Aircraft Maintenance Manual (AMM) for correct value), adjust the active servocontrol as previously explained.
Remove the straight edge and the graduated scale. Remove the safety pins and the warning notices on the side sticks.
Do the operational test of the aileron and hydraulic actuation.
If no other tasks have to be completed, the area can be closed ensuring all tools, test and support used during this procedure are removed.

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE AILERONS

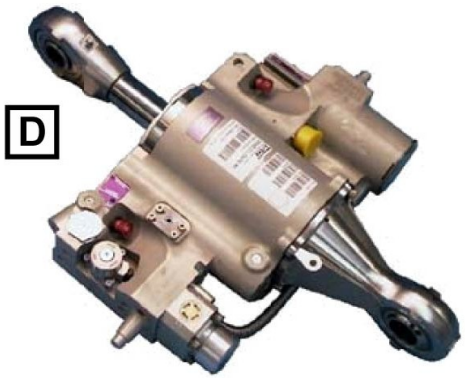
...
Job set-up
...

Make sure that:

...
Procedure
...

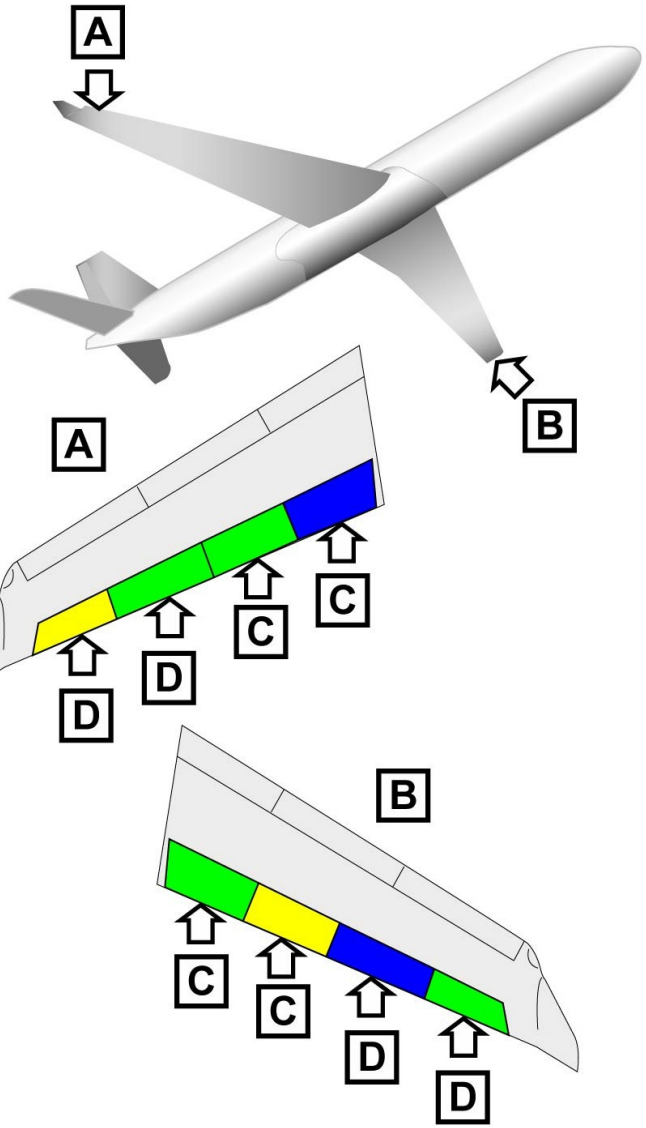
Adjustment of the ailerons:

...
Close-up
...



OUTBOARD AILERON SERVOCONTROL

INBOARD AILERON SERVOCONTROL



ADJUSTMENT OF THE AILERONS

ADJUSTMENT OF THE AILERONS

...

Job set-up

...

Make sure that:

- ✓ - Green hydraulic system pressurized and Blue and Yellow hydraulic systems depressurized.
- ✓ - Flight controls computer P/BSW pressed in.
- ✓ - Flaps and Slats fully retracted.
- - Safety pin and warning notice on side sticks.

...

Procedure

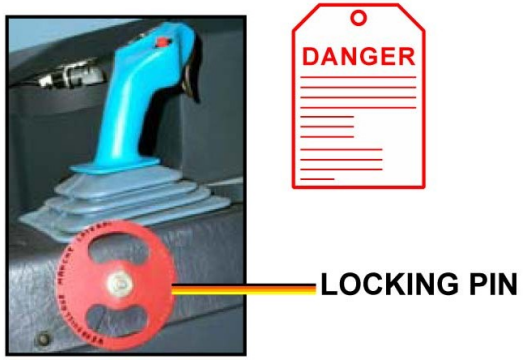
...

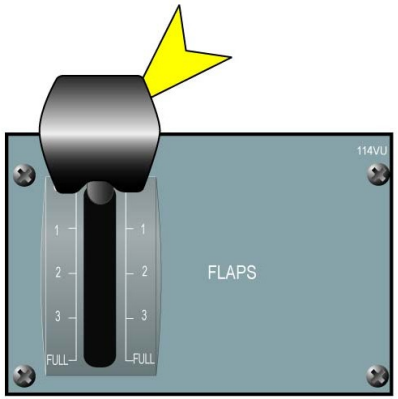
Adjustment of the ailerons:

...

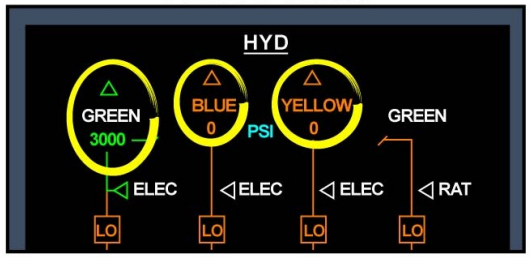
Close-up

...

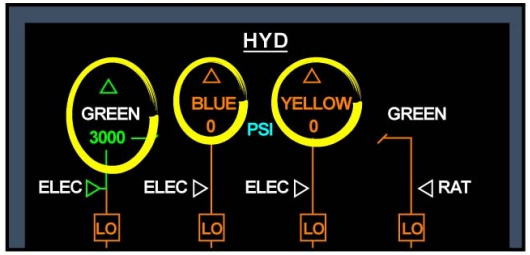


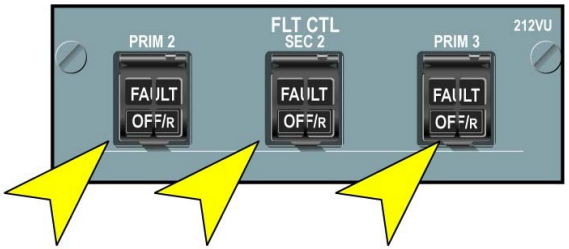


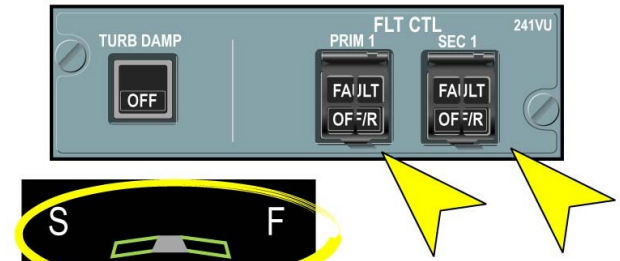
FOR A340-500/600

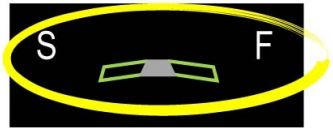


FOR A330 AND A340









ADJUSTMENT OF THE AILERONS

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE AILERONS

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

⇨ **Procedure**

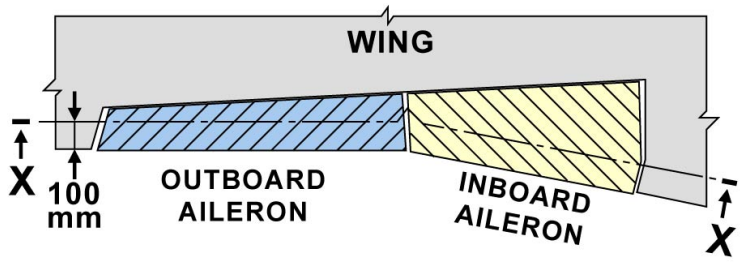
...

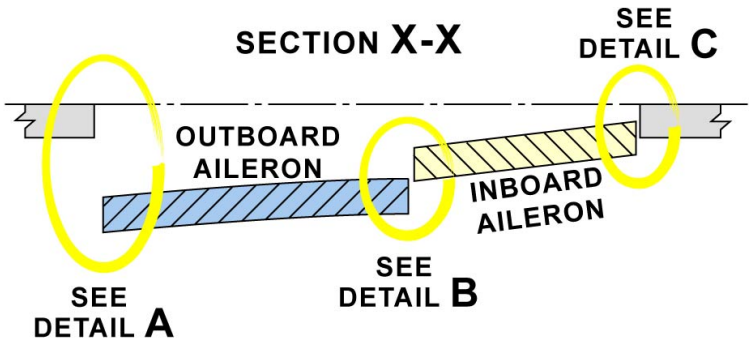
⇨ **Adjustment of the ailerons:**

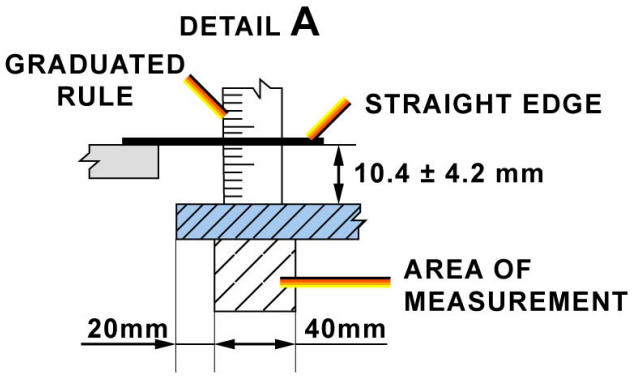
⇨ - Measure the aileron position.

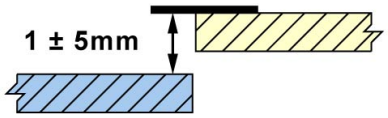
- Adjust the pressurized servocontrol if necessary.
- Pressurize the adjacent servocontrol (Blue or Yellow). Depressurize the Green hydraulic system.
- Measure the new aileron position. Adjust the active servocontrol if necessary.
- Remove the tool.
- Do the operational test.

...

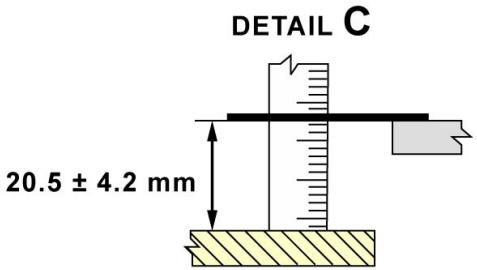








DETAIL B



DIMENSIONS APPLICABLE ONLY ON A340-500/600 (REFER TO AMM FOR A330, A340-200/300)

ADJUSTMENT OF THE AILERONS

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE AILERONS

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

⇨ **Procedure**

...

⇨ **Adjustment of the ailerons:**

✓ - Measure the aileron position.

⇨ - Adjust the pressurized servocontrol if necessary.

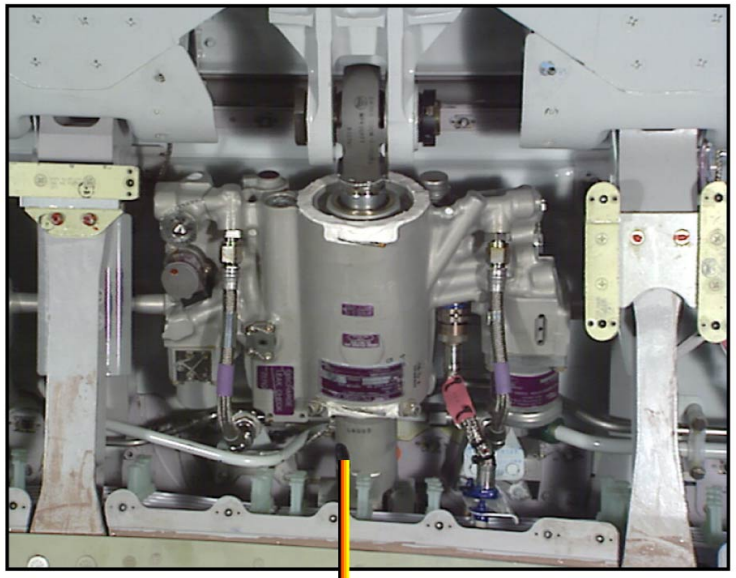
- Pressurize the adjacent servocontrol (Blue or Yellow). Depressurize the Green hydraulic system.

- Measure the new aileron position. Adjust the active servocontrol if necessary.

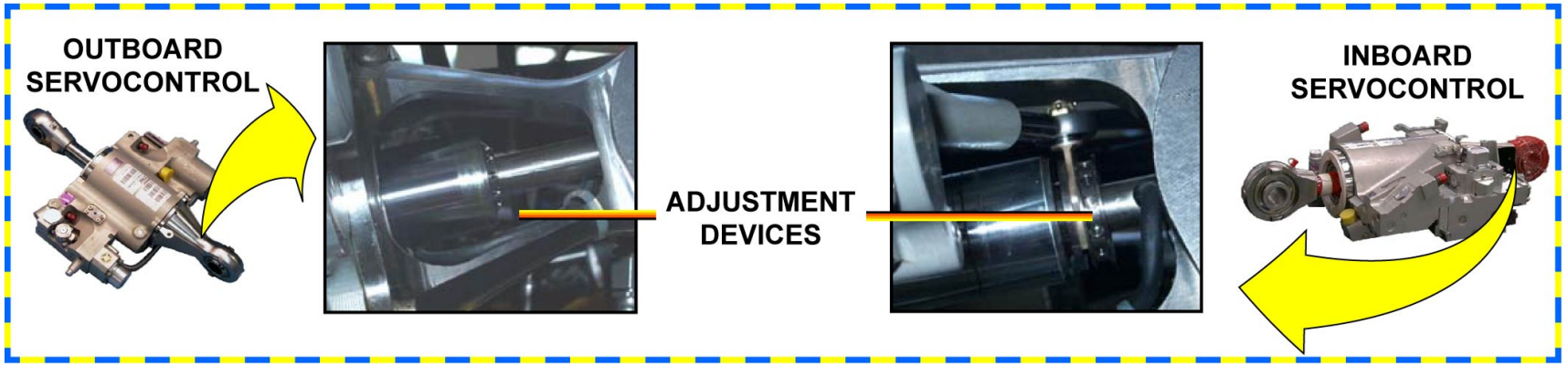
- Remove the tool.

- Do the operational test.

...



A340-600 ONLY



ADJUSTMENT OF THE AILERONS

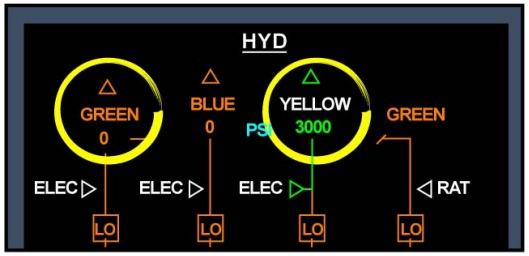
ADJUSTMENT OF THE AILERONS

...
Job set-up
...
Make sure that:
...
Procedure
...
Adjustment of the ailerons:
- Measure the aileron position.
- Adjust the pressurized servocontrol if necessary.
- Pressurize the adjacent servocontrol (Blue or Yellow). Depressurize the Green hydraulic system.
- Measure the new aileron position. Adjust the active servocontrol if necessary.
- Remove the tool.
- Do the operational test.

...

FOR A340-500/600

FOR A330 AND A340



THE OUTBOARD AILERONS HAVE BEEN CHOSEN AS AN EXAMPLE. THEREFORE, THE YELLOW HYDRAULIC SYSTEM MUST BE PRESSURIZED. THE OUTBOARD AILERONS ARE ACTUATED BY ONE GREEN AND ONE YELLOW SERVOCONTROLS.

THE PROCEDURE IS IDENTICAL FOR THE INBOARD AILERONS WITH THE BLUE HYDRAULIC SYSTEM PRESSURIZED.

ADJUSTMENT OF THE AILERONS

ADJUSTMENT OF THE AILERONS

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

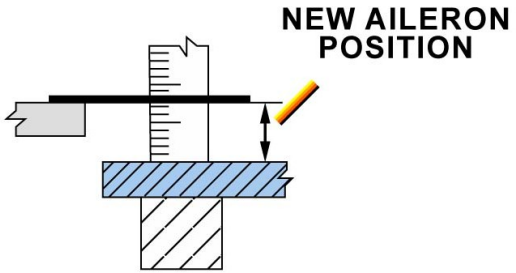
⇨ **Procedure**

...

⇨ **Adjustment of the ailerons:**

- ✓ - Measure the aileron position.
- ✓ - Adjust the pressurized servocontrol if necessary.
- ✓ - Pressurize the adjacent servocontrol (Blue or Yellow). Depressurize the Green hydraulic system.
- ⇨ - Measure the new aileron position. Adjust the active servocontrol if necessary.
- - Remove the tool.
- - Do the operational test.

...



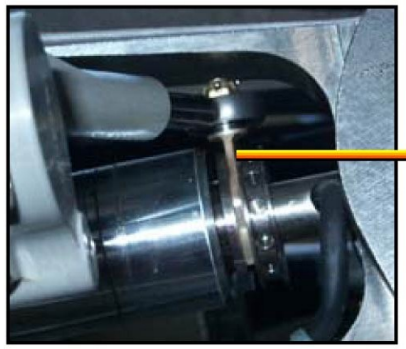
PREVIOUS AILERON POSITION

XX.X mm

NEW AILERON POSITION

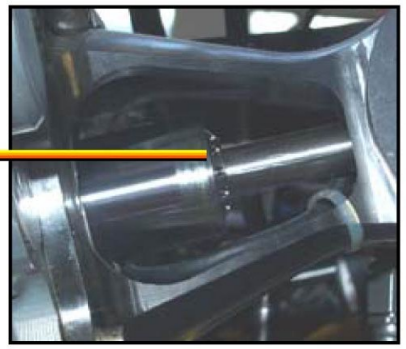
YY.Y mm

IF DIFFERENCE > 1mm ⇨ ADJUST



INBOARD AILERON

ADJUSTMENT DEVICES



OUTBOARD AILERON

ADJUSTMENT OF THE AILERONS

ADJUSTMENT OF THE AILERONS

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

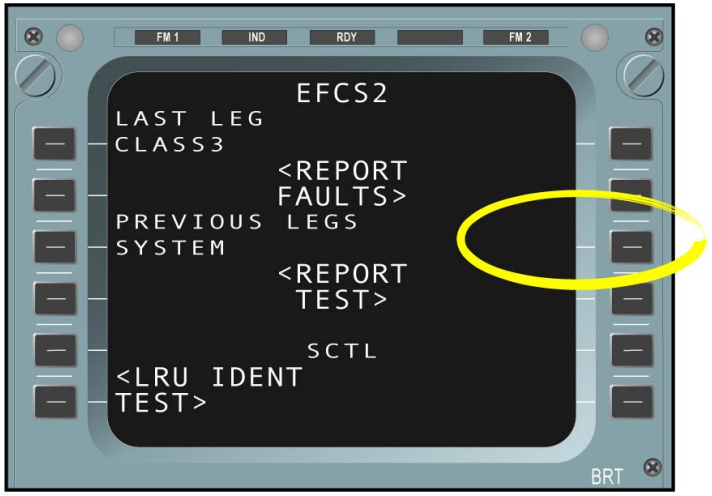
⇨ **Procedure**

...

⇨ **Adjustment of the ailerons:**

- ✓ - Measure the aileron position.
- ✓ - Adjust the pressurized servocontrol if necessary.
- ✓ - Pressurize the adjacent servocontrol (Blue or Yellow). Depressurize the Green hydraulic system.
- ✓ - Measure the new aileron position. Adjust the active servocontrol if necessary.
- ✓ - Remove the tool.
- ⇨ - Do the operational test.

...



ADJUSTMENT OF THE AILERONS

ADJUSTMENT OF THE AILERONS

...
✓ Job set-up
...

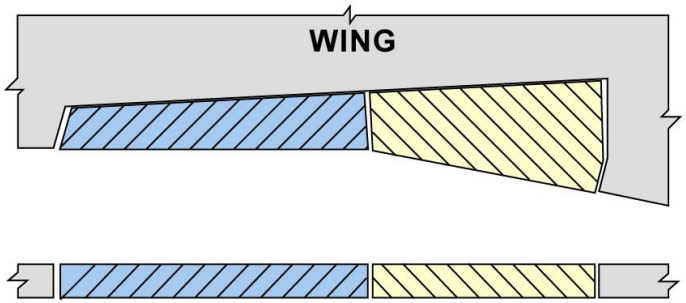
✓ **Make sure that:**

...
✓ Procedure
...

✓ **Adjustment of the ailerons:**

...
⇨ Close-up
...

⇨ - Make sure the work area is clean and clear.



TASK COMPLETED

ADJUSTMENT OF THE AILERONS

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G9409341 - GAUT0T0 - FM27Y2BASEMCE02

FLIGHT CONTROLS SYSTEM BASE MAINTENANCE (3)

ADJUSTMENT OF THE RUDDER

The rudder is actuated by 3 servocontrols. The following procedure gives the adjustment of one servocontrol. The green servocontrol has been chosen as an example, the procedure is identical for the other servocontrols.
On the FLT CTL sections of the overhead panel, make sure that all flight control computer P/BSWs are pressed in (the OFF and FAULT legends are not illuminated).
Install the locking pins and the warning notices on the side sticks and on the rudder pedals.
On the RUD TRIM control panel, make sure that the indicator shows 0.
You also have to place warning notices to tell personnel not to use the rudder trim control panel.
Pressurize the hydraulic system corresponding to the servocontrol to be adjusted. For this example the green one has been chosen.
Make sure that the rudder trailing edge is aligned with the reference triangle on the tail cone. The scale of tolerance is a few millimeters (refer to AMM for precise value).
If the rudder trailing edge is not aligned, you must operate the adjustment device on the rudder servocontrol. Operate this device until the rudder trailing edge is aligned with the reference triangle.
You also have to check that the rigging pins of the rudder position transducers can be inserted and removed freely.
Repeat the adjustment procedure for the two other servocontrols.
Remove the locking pins on the side sticks and the rigging pin on the rudder pedals. Perform the operational test of the rudder hydraulic actuation.
If no other tasks have to be performed, the area can be closed ensuring all tools, test and support used during this procedure are removed.

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE RUDDER

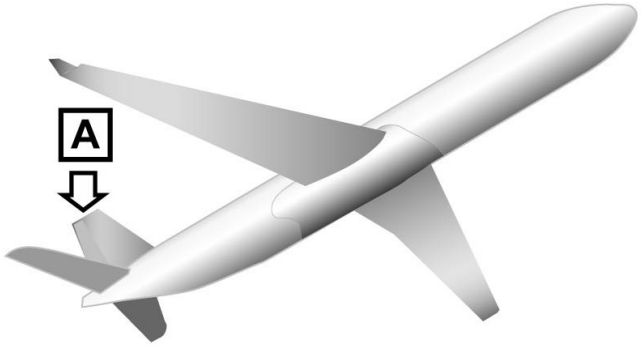
...
Job set-up
...

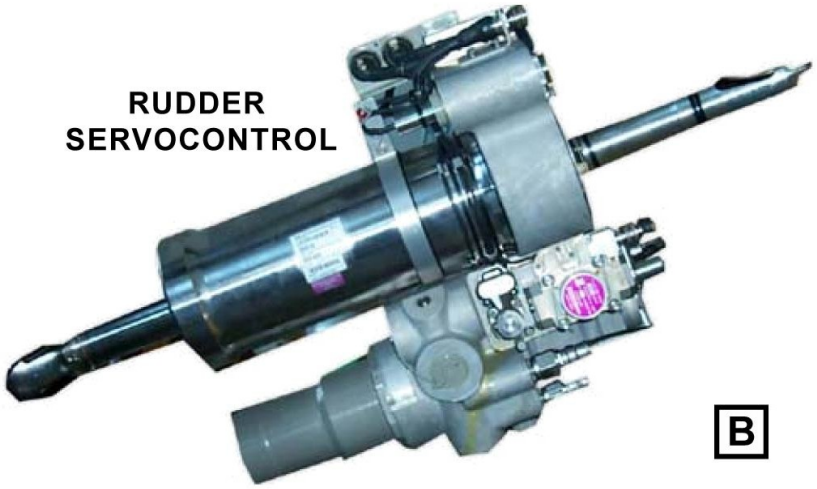
Make sure that:

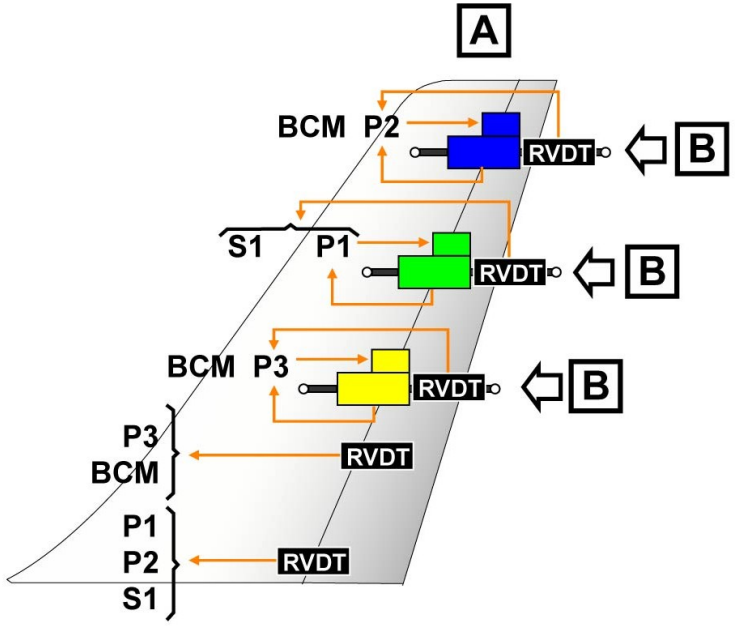
...
Procedure
...

Adjustment of the rudder:

...
Close-up
...







ADJUSTMENT OF THE RUDDER

ADJUSTMENT OF THE RUDDER

...

Job set-up

...

Make sure that:

- Flight controls computers P/BSW pressed in.
- Locking pins and warning notices in position.
- RUD TRIM at 0 and warning notice.
- Green hydraulic system pressurized.

...

Procedure

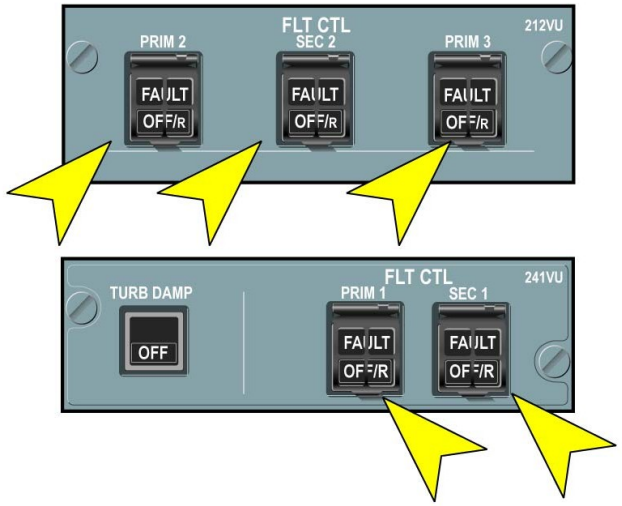
...

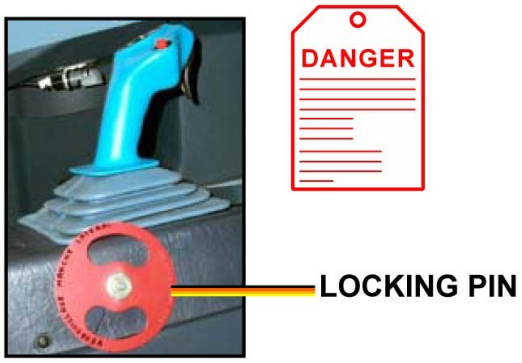
Adjustment of the rudder:

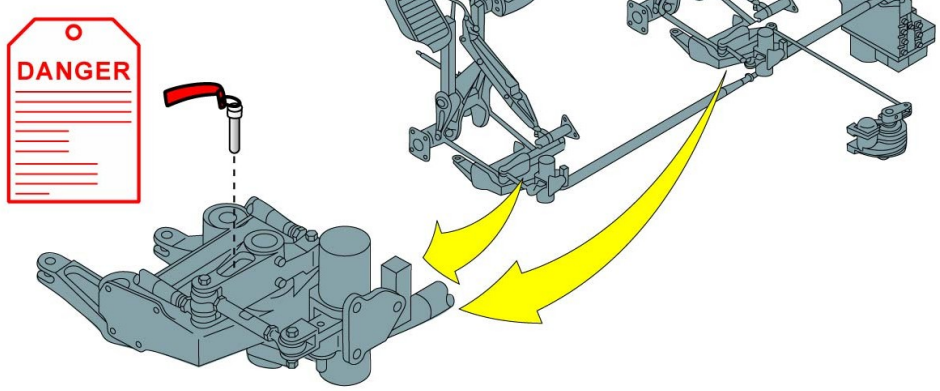
...

Close-up

...







ADJUSTMENT OF THE RUDDER

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE RUDDER

...

Job set-up

...

Make sure that:

- ✓ - Flight controls computers P/BSW pressed in.
- ✓ - Locking pins and warning notices in position.
- ✓ - RUD TRIM at 0 and warning notice.
- - Green hydraulic system pressurized.

...

Procedure

...

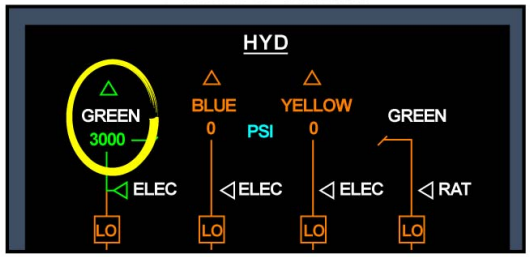
Adjustment of the rudder:

...

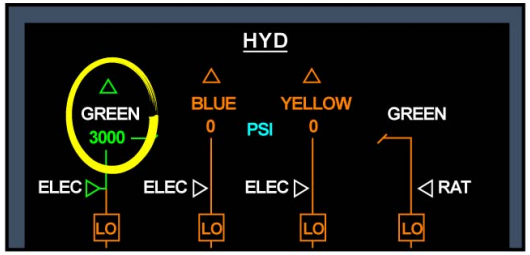
Close-up

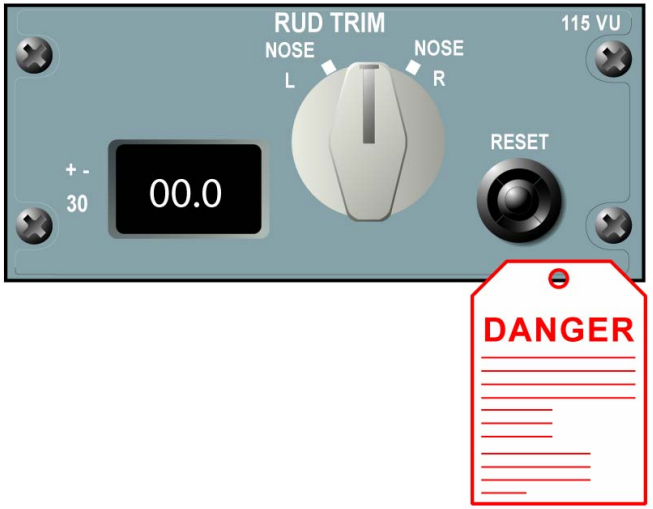
...

FOR A340-500/600



FOR A330 AND A340





ADJUSTMENT OF THE RUDDER

ADJUSTMENT OF THE RUDDER

...
Job set-up
...

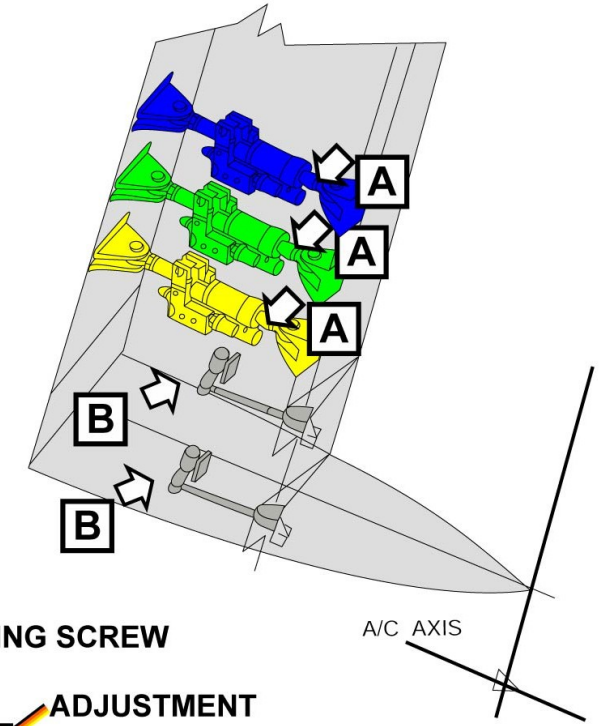
Make sure that:

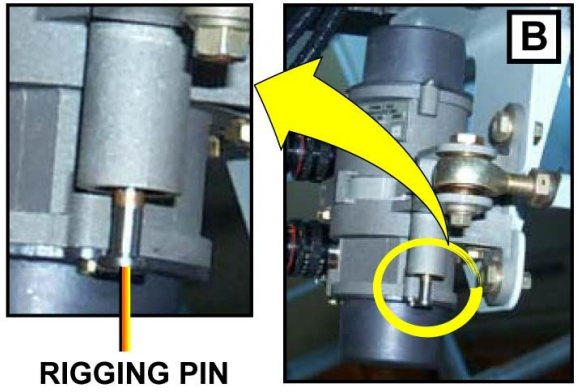
...
Procedure
...

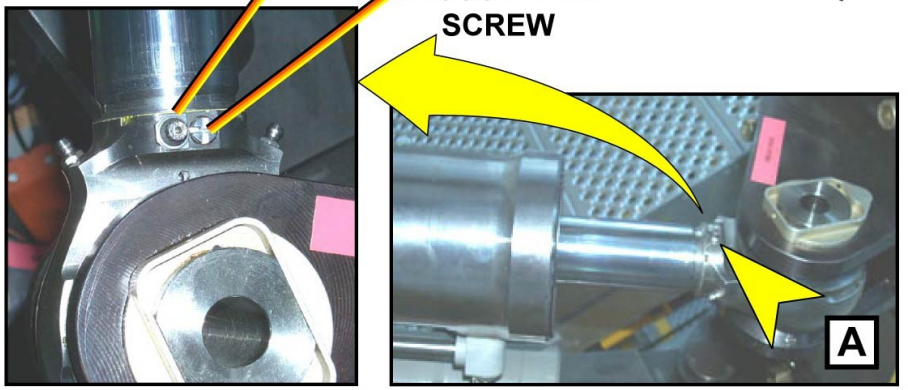
Adjustment of the rudder:

- Check rudder alignment.
- Adjust the pressurized servocontrol if necessary.
- Check the transducers rigging pin.
- Repeat the operation with the two other servocontrols.
- Remove the tools. Perform operational test.

...
Close-up
...







ADJUSTMENT OF THE RUDDER

ADJUSTMENT OF THE RUDDER

...

Job set-up

...

Make sure that:

...

Procedure

...

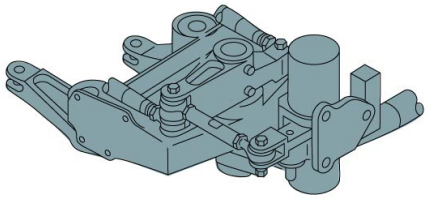
Adjustment of the rudder:

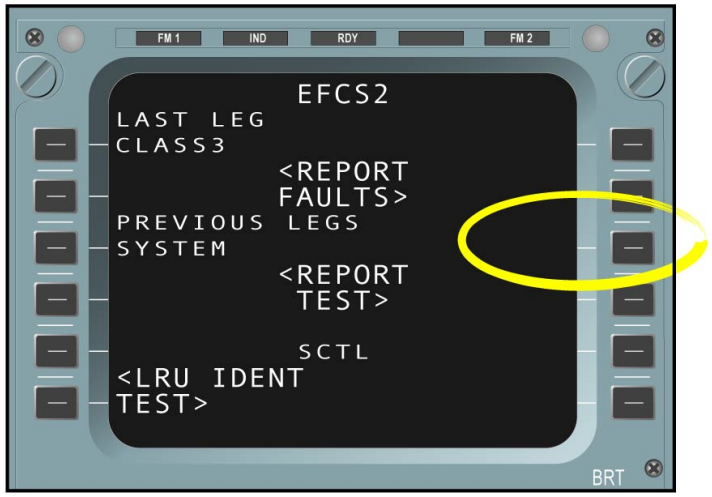
- Check rudder alignment.
- Adjust the pressurized servocontrol if necessary.
- Check the transducers rigging pin.
- Repeat the operation with the two other servocontrols.
- Remove the tools. Perform operational test.

...

Close-up

...





ADJUSTMENT OF THE RUDDER

ADJUSTMENT OF THE RUDDER

...
✓ **Job set-up**
...

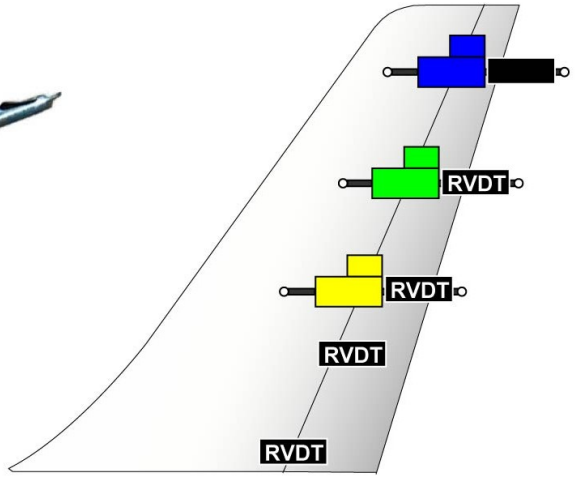
✓ **Make sure that:**

...
✓ **Procedure**
...

✓ **Adjustment of the rudder:**

...
⇨ **Close-up**
...

⇨ - Make sure the work area is clean and clear.



TASK COMPLETED

ADJUSTMENT OF THE RUDDER

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G9409341 - GAUT0T0 - FM27Y2BASEMCE02

FLIGHT CONTROLS SYSTEM BASE MAINTENANCE (3)

ADJUSTMENT OF THE ELEVATORS

The A/C is fitted with two elevators. Each elevator is actuated by two servocontrols. The following procedure deals with the adjustment of the left elevator. The procedure is the same for the RH one.
On the FLT CTL sections of the overhead panel, make sure that all flight controls computer P/BSWs are pressed in (the OFF and FAULT legends are not illuminated).
Trim control wheel for A340. Install the locking pins on the side sticks. You also have to put warning notices in position to tell personnel not to use the side sticks and the pitch trim wheels.
Pressurize the hydraulic systems.
Release out the green LEAK MEASUREMENT VALVE P/BSW (the OFF legend comes on) and note the position of the elevator trailing edge.
Check that the rigging pin of the elevator position transducer unit can be inserted and removed freely.
If not, set the green LEAK MEASUREMENT VALVE to normal (P/BSW pressed in) and set the blue LEAK MEASUREMENT VALVE to "OFF" (P/BSW released out).
For the A330-200/300 and the A340-200/300, loosen the nut and disengage the lock washer. Turn the rod in the correct direction until the transducer unit rigging pin can be inserted and removed freely.
For the A340-500/600, remove the protective plate to gain access to the LVDT adjustment device. Adjust the LVDT until the transducer unit rigging pin can be inserted and removed freely.
Check the new trailing edge position with that recorded earlier. If it is different by more than 3 mm, the servo actuator must be adjusted using the elevator neutral-setting gauge. If the distance between the two positions is less than 3 mm, the servocontrol is correctly adjusted.
Now, adjust the adjacent servocontrol. The procedure is the same as the one done previously.
Once both servocontrols are adjusted, check that all LEAK MEASUREMENT VALVES are pressed in (no OFF legends). Remove the locking pins on the side sticks. Perform the operational test of the elevator and hydraulic actuation.
If no other tasks have to be performed, the area can be closed ensuring all tools, test and support used during this procedure are removed.

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE ELEVATORS

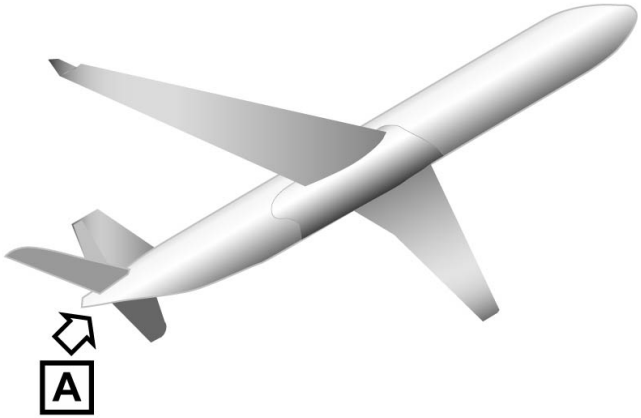
...
Job set-up
...

Make sure that:

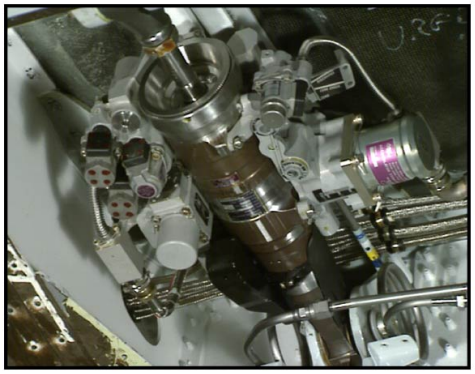
...
Procedure
...

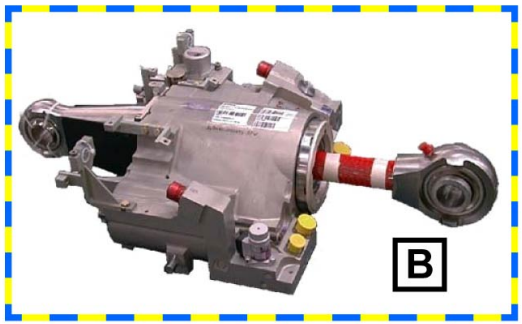
Adjustment of the elevators:

...
Close-up
...



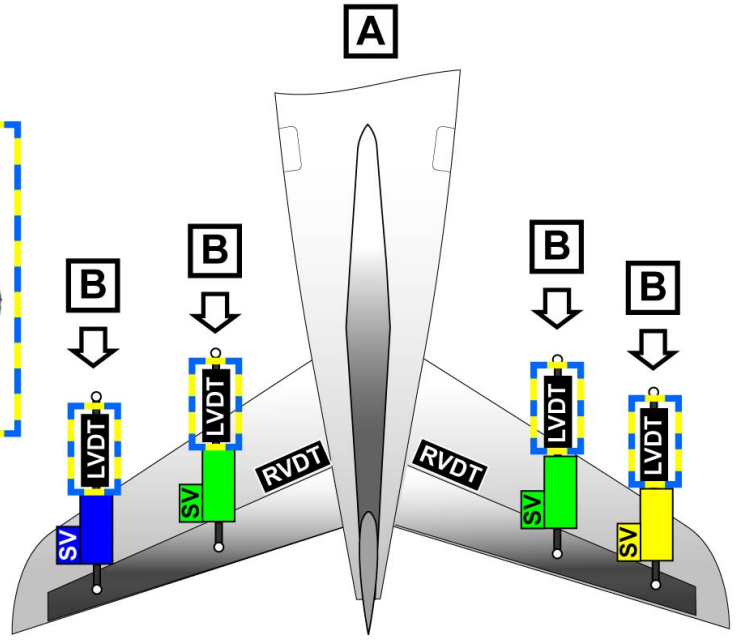
ELEVATOR SERVOCONTROLS





B

A340-600 ONLY



ADJUSTMENT OF THE ELEVATORS

ADJUSTMENT OF THE ELEVATORS

...

Job set-up

...

Make sure that:

- ✓ - Flight controls computers P/BSW pressed in.
- ✓ - Locking pins and warning notices in position.
- - Hydraulic systems pressurized.

...

Procedure

...

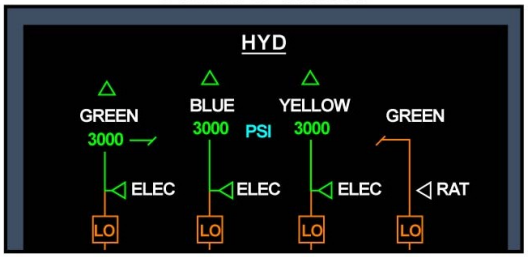
Adjustment of the elevators:

...

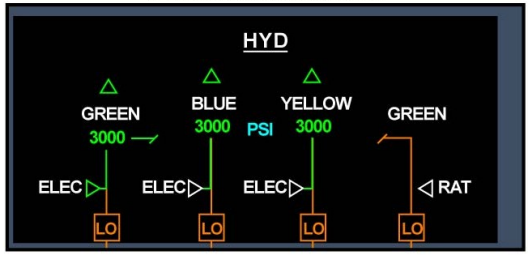
Close-up

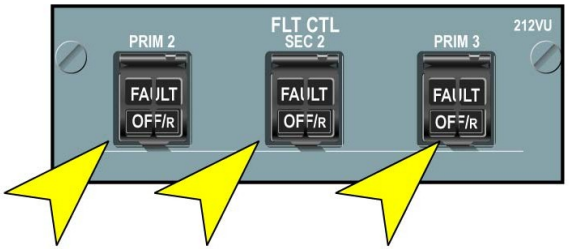
...

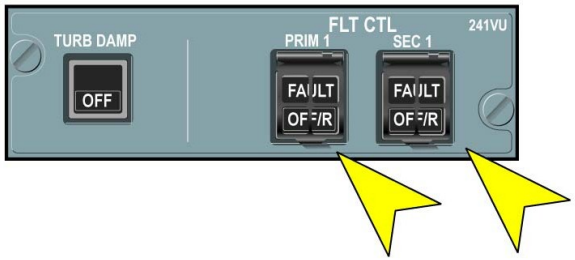
FOR A340-500/600

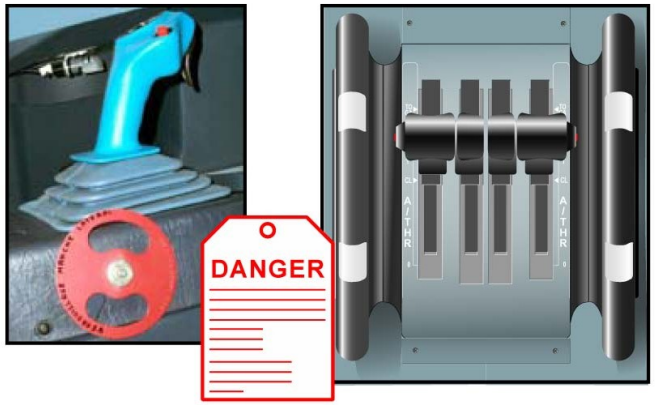


FOR A330 AND A340









TRIM CONTROL WHEEL FOR A340

ADJUSTMENT OF THE ELEVATORS

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

ADJUSTMENT OF THE ELEVATORS

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

⇨ **Procedure**

...

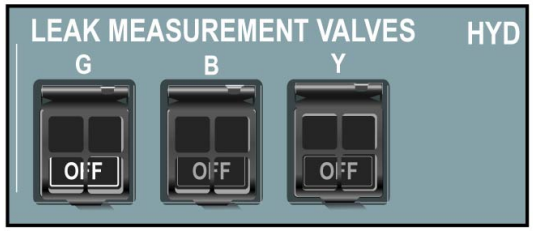
⇨ **Adjustment of the elevators:**

✓ - Green LEAK MEASUREMENT VALVE pbsw release out. Note the elevator position.

⇨ - Check the transducer rigging pin free insertion and removal.

- If not, Green back to normal and Blue "OFF".
- Operate the elevator adjustment device.
- Check the new elevator position.
- Repeat the operation for the adjacent servocontrol.
- Check LEAK MEASUREMENT VALVES pressed in. Remove the tools. Perform operational test.

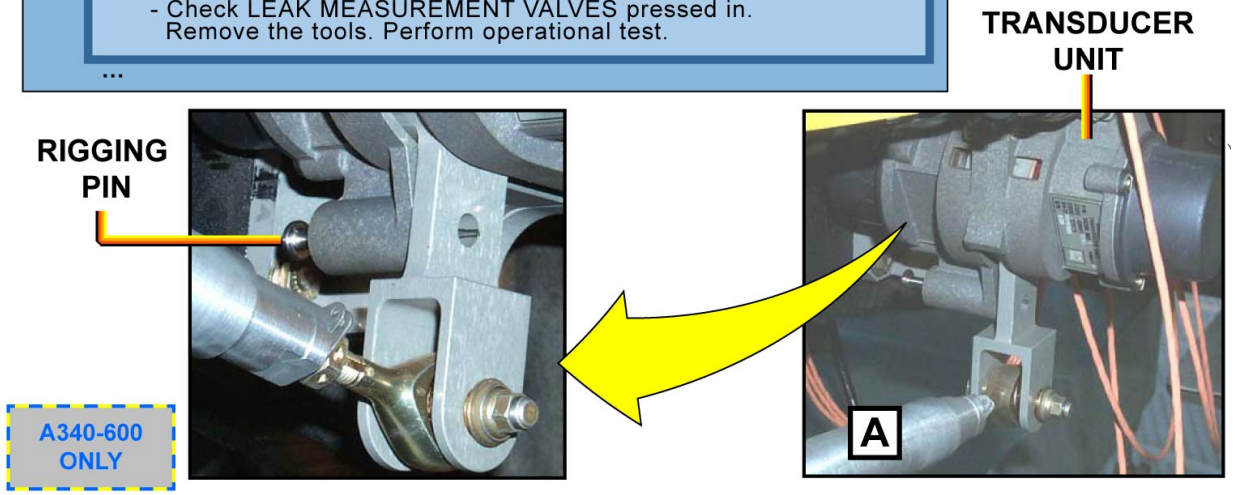
...

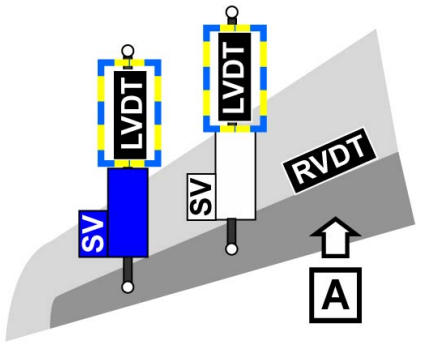


(285VU)

ELEVATOR POSITION

XX.X mm





LEFT ELEVATOR

ADJUSTMENT OF THE ELEVATORS

ADJUSTMENT OF THE ELEVATORS

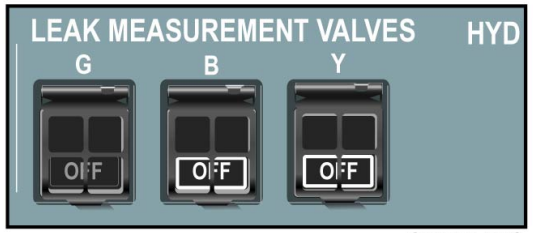
...
Job set-up
...
Make sure that:
...
Procedure
...
Adjustment of the elevators:
- Green LEAK MEASUREMENT VALVE pbsw release out. Note the elevator position.
- Check the transducer rigging pin free insertion and removal.
- If not, Green back to normal and Blue "OFF".
- Operate the elevator adjustment device.
- Check the new elevator position.
- Repeat the operation for the adjacent servocontrol.
- Check LEAK MEASUREMENT VALVES pressed in. Remove the tools. Perform operational test.

...

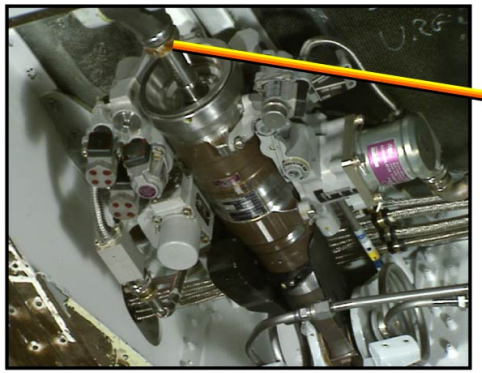
PREVIOUS ELEVATOR POSITION
XX.X mm

NEW ELEVATOR POSITION
YY.Y mm

IF DIFFERENCE > 3 mm ⇨ Neutral setting gauge

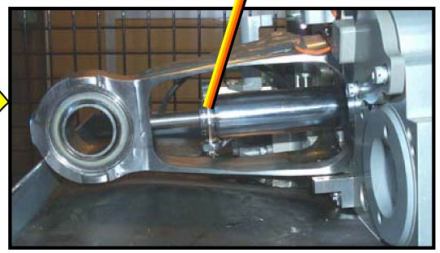


(285VU)



ADJUSTMENT DEVICES

A340-600 ONLY



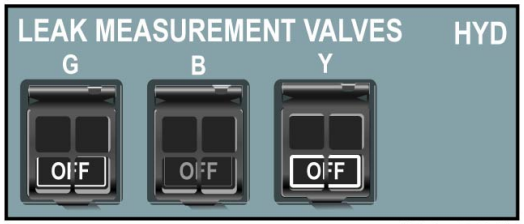
GREEN SERVOCONTROL

ADJUSTMENT OF THE ELEVATORS

ADJUSTMENT OF THE ELEVATORS

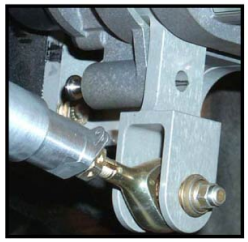
...
Job set-up
...
Make sure that:
...
Procedure
...
Adjustment of the elevators:
- Green LEAK MEASUREMENT VALVE pbsw release out. Note the elevator position.
- Check the transducer rigging pin free insertion and removal.
- If not, Green back to normal and Blue "OFF".
- Operate the elevator adjustment device.
- Check the new elevator position.
- Repeat the operation for the adjacent servocontrol.
- Check LEAK MEASUREMENT VALVES pressed in. Remove the tools. Perform operational test.

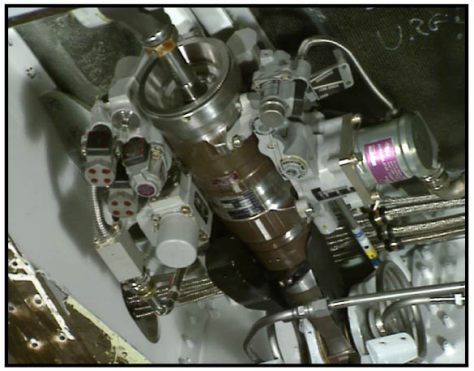
...



(285VU)

TRANSDUCER RIGGING PIN





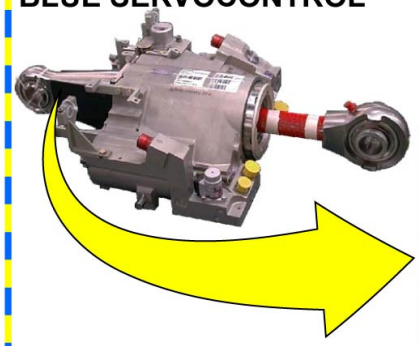
PREVIOUS ELEVATOR POSITION
XX.X mm

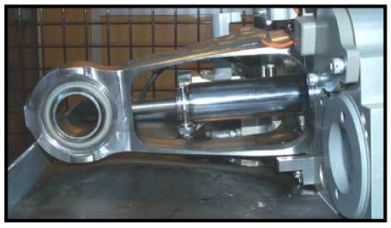
NEW ELEVATOR POSITION
YY.Y mm

IF DIFFERENCE > 3 mm ⇨ Neutral setting gauge

BLUE SERVOCONTROL

A340-600 ONLY





ADJUSTMENT OF THE ELEVATORS

ADJUSTMENT OF THE ELEVATORS

...

Job set-up

...

Make sure that:

...

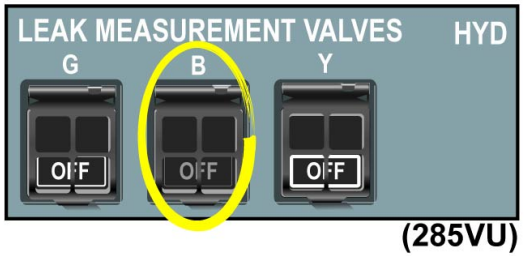
Procedure

...

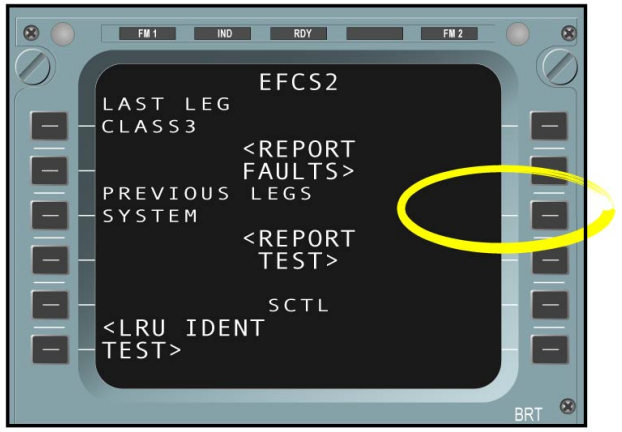
Adjustment of the elevators:

- Green LEAK MEASUREMENT VALVE pbsw release out. Note the elevator position.
- Check the transducer rigging pin free insertion and removal.
- If not, Green back to normal and Blue "OFF".
- Operate the elevator adjustment device.
- Check the new elevator position.
- Repeat the operation for the adjacent servocontrol.
- Check LEAK MEASUREMENT VALVES pressed in. Remove the tools. Perform operational test.

...



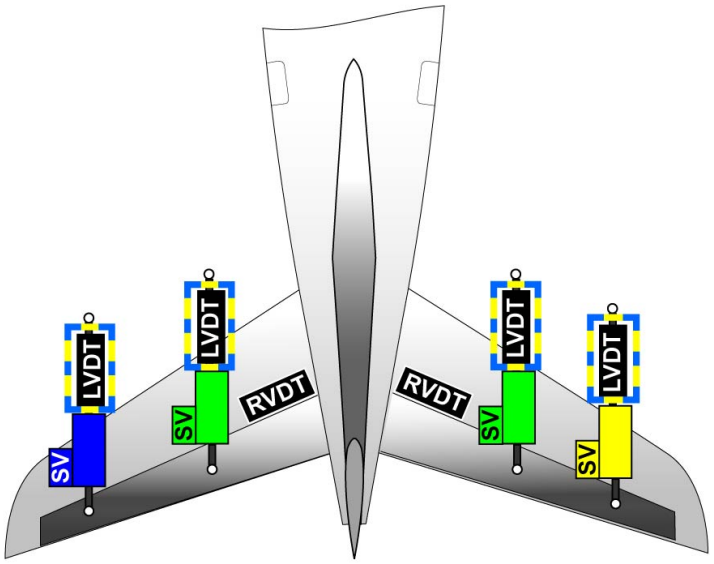
(285VU)

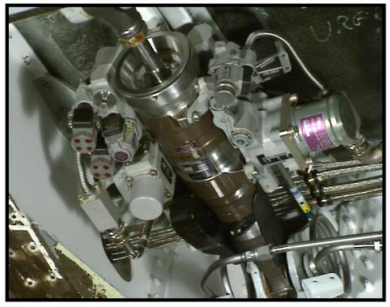


ADJUSTMENT OF THE ELEVATORS

ADJUSTMENT OF THE ELEVATORS

...
✓ Job set-up
...
✓ Make sure that:
...
✓ Procedure
...
✓ Adjustment of the elevators:
...
⇨ Close-up
...
⇨ - Make sure the work area is clean and clear.





TASK COMPLETED

✓

A340-600 ONLY

ADJUSTMENT OF THE ELEVATORS

G9409341 - GAUT0T0 - FM27Y2BASEMCE02

AIRBUS

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